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EDITORIAL NOTES—GAS, &c.

Work for the Private Bill Authorities.

THERE is work for Parliament to do in connection with the finances of municipal trading concerns. During the proceedings in a very recent arbitration, there was contention from both sides (which we will not discuss at the moment) which read together shows that Parliament is not acting consistently in the matter of refusing to allow the transfer of net profits in aid of the rates, or of limiting the amount that may be so transferred. Parliament limits the profits of statutory gas companies; and in conjunction with the special purposes clause, it is restricting the amount of the carry-forward. It therefore follows that, in justice to municipal gas consumers, there should be a limitation of the profits that may be appropriated for the rates, or better still, if full justice is to be done, there should be complete inhibition. The customers of a municipal gas concern pay interest on the money borrowed for it; they supply the money for the sinking and reserve funds; they maintain the undertaking; and they supply the revenue for meeting all the financial obligations, including rates and taxes. Surely there is profit enough represented in certain of these items; and when the consumers have supplied these sums, they have assuredly done sufficient without in perpetuity furnishing money to lighten the rates—in some notable instances, to an extent, in the aggregate since the concerns have been municipal possessions, in excess of the sum of the loans. We fail to see the justice of this. In the coming session, Parliament has a good opportunity of showing more consistency, and of revising stereotyped clauses that give unlimited powers to local authorities.

The Purchase Bills that have been introduced in Parliament for the coming session are the Ashborne, Bedwellty, Cannock, and Sidmouth. They remind us that in all Gas Purchase Bills nowadays, there is a clause providing for the application of the revenue; and the clause concludes by giving the councils concerned an unlimited power to carry to the district fund any balance remaining in any year. A council may, under such circumstances, administer an undertaking in any manner they desire to make the balance as large as possible. There is work there for Parliament in rectifying this, and in protecting the gas consumers by specifying what (if any) shall be the percentage of benefit the district fund shall derive, if net profit is available. Of course, it will be pointed out that the next clause should be read in conjunction with the liberty of profit appropriation. This clause provides for any deficiency in the revenue of the gas undertaking being made good out of the district fund. The gas undertaking that has ever had to apply to the district fund for relief is a rarity; and local authorities would soon exercise their powers of charge to prevent the dipping by a gas undertaking (an electricity undertaking is more petted) into the district fund. There is also some work at hand for Parliament in revising this clause. If profit appropriation for the rates is prohibited, then it follows that assistance rendered to the undertaking by the district fund should be made a debt repayable to the fund from future profits. Yet another matter. Some authorities compel the gas undertaking, and consequently the gas consumers, to supply gas free for public lighting purposes. This, again, is casting on the gas consumers the cost of a public service that should be borne by the general body of ratepayers. There is likewise some revising work here for the parliamentary authorities.

These are matters that are dealt with by clauses in the Bill promoted by the outside authorities of Salford, which Bill the Local Government Board are seemingly throwing obstacles in front of, to prevent its appearance in the parliamentary arena, where in 1909 the first "round" in this contest took place. It is quite a pious desire on our part that the Board may not succeed. This reference to the Local Government Board reminds us that there are several of the local authorities who will be before Parliament in the approaching session who desire unrestricted borrowing powers through the Board. The capital and borrowing powers of statutory gas companies are limited, for the purpose of bringing the companies periodically under the review of Parliament. For precisely this very reason, the Unopposed Bills Committee last session decided to restrict the borrowing powers of the Milford Haven District Council in respect of their gas undertaking; and there was an intimation that this was a matter the parliamentary authorities were proposing to keep under closer surveillance. Attention to these various matters would put statutory enactment relating to the finances of both gas supplying local authorities and companies on greater equality, and would at the same time relieve municipal gas consumers of burdens that, in equity, they ought not to be called upon to bear.

The local authority Gas Bills for the session are reviewed in other columns. Mention has been made of the four Purchase Bills. It does not appear in the cases of Ashborne and Sidmouth that the prices of transfer have been agreed upon; but in respect of Bedwellty, an agreement exists with the Tredegar Gas and Water Company, but not, so far, in respect of the Blackwood Gas Company. The Cannock purchase scheme was also intended to be upon an agreed figure. But there has been keen local opposition; and a poll of the ratepayers was taken last Saturday. With a seriously conducted campaign in favour of the purchase, the result of the poll is that only 881 ratepayers supported it by their votes, while 1108 deliberately set their hands against it. But there are 5649 voters in the area; so that some 65 per cent. did not trouble themselves about the matter. However, the veto of ratepayers in the case of a proposal for municipal trading has again prevailed. The more notable among the remaining gas measures are those from Birmingham, Belfast, and Salford—notable on account of the considerable gas-works schemes that they foreshadow. Birmingham is proposing the purchase of between 36 and 37 acres of additional land; but no estimates are included in the Bill in this connection. The estimates for Belfast amount to £400,000, including land purchase; while those for Salford total to £250,000. These three extension schemes will therefore represent together a substantial sum.

The Ilkeston Gasholder Disaster.

THE inquest upon the body of the young servant girl who was drowned in a cellar at Ilkeston as a consequence of the recent disaster to a gasholder, has been held; and it supplies the present available technical evidence as to the origin of the disaster. The drowning of the poor girl was an indirect effect, and not a direct one, of the accident, being contributed to by the blameless mistake, through fright, of taking refuge in the cellar of a house in proximity to the catastrophe. There was no question as to the cause of death; and the verdict of the jury pointed to what is the technical belief, that the escaping water which occasioned the flooding was due to a rapidly occurring series of events, commencing with the jamming of the spirals of the holder.

All the technical evidence was furnished by Mr. F. C. Humphrys (the Corporation Gas Engineer), Mr. Samuel Glover, and Mr. J. Ferguson Bell; and they themselves—not having been eye-witnesses, but having only the results of the disaster upon which to construct an explanation of the occurrence—have to admit that their views are more or less based on hypotheses, which, however, have a fairly

reasonable substratum. There were several contributory factors; but something extraordinary happened (something that may never happen anywhere again) to have produced the initial one, as the prevailing circumstances at the time were not so severe as the holder has been exposed to during its three successful working years. All three technical witnesses agree that there was a locking of the outer lift—an unpleasant occurrence that most gas engineers have experienced without its involving the dire results of the present event. Through the locking, the gas escaped at the outer lift by the unsealing of the cup. Unusual strains had by this time been set up. Then down came the inner lift with a run, which produced shock in the tank. The shock coming on top of the strain caused by the locking, it is suggested, resulted in the fracture of the tank sufficient to allow the water to break loose. The tank containing 1¼ million gallons, the pressure on the fractured plate would be enormous. It seems to be pretty clear that abnormal violence was, by the chain of circumstances, brought to bear upon the steel tank.

There is another question. Close inquiry was directed to the point as to whether the firing of the escaping gas was also a contributory cause; but no one was prepared to speak definitely as to this. There was, however, some suggestion that the heat of the flame of the liberated gas may have had some effect on the holder. The combustion of the gas seems to have been so rapid as to be fairly describable as almost momentary. Under such circumstances, the heat could not have had much influence. There may have been something in the nature of a mild explosion in the outer atmosphere; and this may have contributed to the shock. But the evidence appears to discount this, and suggests that nothing more than the inflammation of the gas occurred. The suddenness and rapidity of the whole event blotted out all opportunity for any exact observation. Mr. Humphrys was on the works at 1.10. He passed beyond range of knowledge of what was happening, visited his home for dinner, was resummoned to the works, and reached there again at 1.40—all had commenced and finished without his knowledge within a few minutes in the middle of that short half-hour.

It is quite possible that this occurrence will have raised some doubts in the minds of the authorities at the Local Government Board as to the validity of the claim to safety of this particular type of gasholder construction. Let us point this out to them—that spiral-guided holders have a clean record over a long series of years. There are much larger holders on the system, and of more lifts than this one, in daily operation, and in much more exposed positions. This particular one has worked without a hitch for three years, and in varied extremes of weather of greater intensity than anything that existed on this occasion. Again, there are holders that have been working on this plan in overground steel tanks for a longer period than this one, and with the plates and other members in the tanks of the same thickness and strength (which are normal for this size holder). The perpendicularly fractured plate exhibits no evidence of an old crack. To all appearances the plate is quite normal. Whether any closer scientific examination would disclose any inherent weakness that is not otherwise visible, we, of course, do not know. On the spirals, no evidence of hard jamming can be detected. Any suggestion as to the prevailing atmospherical conditions on the day of the accident exposing a weakness of the system as such, is effectually answered by merely pointing to holders on the system erected in other countries and in this country that are subjected to more severe variations of conditions. This accident, in the face of the standing evidence, proves nothing to the detriment of the spiral-guided system. Of course, it might be possible to strengthen overground steel tanks to an extent that would resist the peculiar series of strains and stresses to which this one appears to have been subjected; but the same similar set of conditions may never recur anywhere.

Free Gas Appliances or Low Rentals.

Too much stress cannot be laid upon the value of the development of the day load of gas undertakings, nor can there be too much consideration given as to how best this is to be done. At the same time, the lighting business must not be neglected. For the increase of the lighting business, the gas industry can mainly only look for its expansion to the growth of areas and populations, and to further pre-payment consumers, inasmuch as the incandescent burner and electrical competition have put the brake on the rate of extension of business in this particular direction. The two principal cities of Scotland have felt this; and these two cities do not appear to have done so much in developing the domestic day load as have some other towns in Scotland, and most towns in England. What should be done in this regard in Glasgow and Edinburgh is discussed in two exceedingly interesting reports we publish this week elsewhere.

Glasgow have already settled their line of policy by determining on the supply of gas appliances free for domestic purposes; while the Edinburgh authorities were considering yesterday reports by their Consulting Gas Engineer (Mr. W. R. Herring), the Acting Engineer (Mr. A. Masterton), and the Treasurer and Collector (Mr. A. Canning Williams). Mr. Herring's report is the one published in conjunction with that from Glasgow in this issue. In Edinburgh there has been an actual decrease in gas consumption, despite the growth in the number of consumers. When, however, Mr. Herring is able to point to the fact that the number of stair lights in the city has increased by upwards of 2000, and that of the public lamps by a few hundred, and yet the consumption of gas for these purposes has decreased by 52 million cubic feet compared with five years ago (the public lamps have been converted to the inverted type), it is pretty plain that, in the more economical use of gas due to more efficient appliances, we have one of the capital causes of general decrease, and of the diminished average consumption per consumer. In the interests of the undertaking, a serious attempt has to be made to obtain compensation for the loss. As is recognized in the report, the greater the consumption, the lower falls the average per 1000 cubic feet of many of the charges; whereas if there is an actual decrease in consumption, the higher the average charges become.

To extend the consumption of gas is the object of both the Glasgow and Mr. Herring's reports; and they agree that the more economical expansion to-day, while maintaining the present lighting load, is to be effected during the daylight hours. How best to do this is the question. The matter has to be considered in relation to the influence of the daylight load upon the entire undertaking. It must be admitted that there has been in the past a little too much stringency in trying to make the hiring *per se* of domestic and other appliances pay, irrespective of consideration as to how the development of the business in this direction affects the fortunes of an undertaking as a whole. We cannot afford to neglect this aspect of affairs in the present day. When it is seriously pondered, it is abundantly obvious that the gas industry, with its, generally speaking, flat-rates for domestic supply, is in a far superior position for developing the domestic day load than the rival industry already committed to prices for day purposes representing only 20 to 25 per cent. of the prices charged for lighting, thus allowing no further operative margin for competitive purposes. This advantage is recognized by both the Glasgow report and that made by Mr. Herring. The latter suggests low rental charges for appliances, domestic and industrial, to partly cover capital charges; while Glasgow, as reported, have adopted the free supply of cooking and such-like appliances, under certain regulations, to ensure their proper use.

There is argument to be adduced in favour of both these policies. A low rental charge is a protection against dormant appliances, while, on the other hand, the regulations at Glasgow will prevent consumers retaining free cookers and other appliances in a state of idleness. There are various instances—Manchester, Dundee, and Paisley are quoted in the Glasgow report—that indicate the salutary influence upon the gas business of the free supply of domestic appliances. On the point as to the propriety of the free supply of domestic cooking appliances, there is no very substantial argument that can be advanced against it. When the general economy of the supply is considered, as it is in the Glasgow report, there is reason enough found in favour of a lower price for the gas supplied for this purpose. But if, in place of a lower price, there is no charge for stove-rental, the same end is reached, and the business receives perhaps more encouragement than it would do with a differential price and a stove-rental, from the mere fact that people are mostly disposed to consider that they have done a good stroke of business in securing the use of such an article of utility without paying a penny piece for it. The day load has to be developed. The decision come to in Glasgow, and the discussion in Edinburgh, we hope will stimulate the more general consideration of the question.

Direct Recovery of Ammonia.

If we glance back over the history of the processes associated with the destructive distillation of coal and the treatment of the bye-products, it is, in several directions, seen how susceptible they have been to changes having for their object enhanced economy and improved result. There is one direction in which, through a long series of years, there have been attempts at producing a revolution from established method, and that is in the matter of the direct recovery of ammonia in the form of sulphate as an integrant of the system of coke-making plant. We have yet to see a complete demonstration of the practicability of such a system as applied to gas-works; and this suggests that it is a little curious there has not been a greater manifestation of interest on the part of gas engineers in the potentialities of the system than has hitherto been evinced. The saving of the storage and the handling of ammoniacal liquor, and the avoidance, or considerable reduction of the volume, of the effluent resulting from sulphate of ammonia manufacture on existing lines (the disposal of which effluent is sometimes found to be a nuisance without treatment) are among the advantages claimed by those who have pursued investigation, and given birth to invention, in the matter of the direct recovery of ammonia. For those who have so worked in this field, the process has fascination; and they are persuaded as to the feasibility of its introduction into the ordinary operations of gas-works, and of coke-oven and kindred plants. What is now wanted is a practical working trial, and the production and cost results.

The subject comes forward again on the information regarding the success of Mr. John Radcliffe (whose system of rendering innocuous the effluent liquor of sulphate of ammonia plants is well known) in establishing before the Comptroller-General of Patents his claim to distinctive features in his process for the recovery of tar, tar vapour, and ammonia from the gases resulting from the carbonization of coal; and the article upon the subject in subsequent columns shows to what simple lines the direct recovery of ammonia has been reduced, and lines that promise a high pitch of efficiency, providing only that the treatment has no deteriorating effect upon the quality of the gas. The workers hitherto have followed much the same route in method, though each one appears to have made some advance upon his predecessors. The essentials are well understood. The elimination of tar and tar vapour is a necessary preliminary, in order to avoid contamination and discoloration of the sulphate; and this is, in most of the proposals that have come to the front, accomplished in oil-fed scrubbers. The next part of the process is the recovery of the ammonia in saturators in contact with sulphuric acid. These are the simple bases of among the others Mr. Radcliffe's system; but the distinguishing feature of his plan of working is that he maintains the temperature of the gas throughout the process sufficiently high to prevent the condensation of water vapour, and this without any assistance from outside sources of heat—the water vapour passing away with the gas at the exit of the ammonia-saturator. This feature the Comptroller-General could not find had been anticipated, though Herr Feld opposed the granting of a patent on the ground that he held the master-patent, which was contested. The point as to the maintenance of the temperature of the gas throughout the process suggests that the nearer it can be carried out to the retort-benches or the coke-ovens, the better. The supplanting, however, of the separate method of sulphate of ammonia manufacture by introducing such a process into the normal course of gas-manufacturing operations is a revolutionary proposal, the headway of which will depend on the proof of the balance of advantage being on its side.

Distribution Problems.

The problems that face the engineer responsible for the maintenance of a sufficient delivery of gas in all parts of an extensive district, comprehending a large diversity of conditions, are often of a more complicated nature than are the problems that face the engineer whose work is confined to the production of the gas. Papers such as that read by Mr. James Hewett, at the meeting of the Midland Junior Gas Association last Saturday, are illustrative of the point. Mr. Hewett is the responsible Distribution Engineer to the Birmingham Corporation Gas Department; and that city typifies well the diverse factors that have to be negotiated in distribution, so as to maintain supply in a state of efficiency. The communication before us does not lend itself to very much criticism or comment, as it is composed of a clear and concise description of the circumstances of Birmingham as seen by the distributing engineer, of the methods adopted in keeping district pressure records, of the problems that confronted the author in considering the supplementing of the supply of gas to two different quarters of the city where the local pressures were apt to run down to an uncomfortably low point, and of an account of how they were solved. We do not think there will be anyone who will be inclined to question the decisions arrived at. An outsider cannot possibly see so well as the man who has intimate knowledge from daily experience (and therefore all the details at command) what is best in this respect under a given set of conditions; and in these cases, the objects sought have been attained, and at reasonable cost.

In the details supplied, considerable value will be found by anyone faced with similar problems, and particularly so in the details associated with the improvement of the supply in the south-western district of the city by means of an auxiliary high-pressure supply. Of course, it does not always follow that, under every circumstance, a supplementary high-pressure system will prove the most economical for bringing the supply of an area up to a condition to adequately meet present needs, and with a margin for prospective development. But the more experience that is collected, the more favourably impressed are engineers with the facility and elasticity offered by a high-pressure system for maintaining an equilibrium between supply and demand, with a greater constancy of pressures than can be obtained under any ordinary low-pressure system, which has not the capacity for responding to requirement in the prompt manner that the auxiliary high-pressure system offers. A distributing engineer feels safe when he has at his back a high-pressure service that he can bring to bear on the weakest quarters in his distribution system, or, at the times of maximum draught, upon those quarters where the demand for gas is most variable. "Despite competition," remarks Mr. Hewett, "the prospect for town's gas was never more "favourable than at the present time; but to reap the full "benefit, the supply must be maintained to the satisfaction "of the consumers." This may be a commonplace; but it is very true. It is its recognition that is responsible for the large favour of the method of boosting supplies, combined with the intrinsic merits of the system.

There are several instructive subsidiary points in the paper besides the solutions of the problems that formed the main part. The value of an air test in laying high-pressure mains is shown by Mr. Hewett. Although the pipes had withstood a hydraulic test of 200 lbs. to the square inch at the foundry, when laid a few of them were found to be leaking through the face of the sockets. The table giving the pressure corrections for level on the basis of one-tenth of an inch variation in 12 ft. 6 in. rise or fall of main (which is about the average in the Birmingham area), will be found useful; while the consumption curve is extremely interesting. It exhibits how fairly regular morning consumption is getting both in winter and summer; and it indicates, too, how the cooking and industrial loads play a part in this. Further in respect of the morning gas consumption, there is not the wide difference now that one might have expected between mid-summer and mid-winter weekdays, and mid-summer and mid-winter Sundays. However, the full technical value of the paper can only be realized by a careful study of its complete contents.

Seductive Salford.

By every move, the Salford Corporation show that they realize how absolutely the outside authorities have put them in a corner over the question of the application of gas profits to the relief of the rates. It is really curious to see Salford going so persistently cap in hand to the Eccles Corporation and the District Councils concerned. It exemplifies the strength of the latter and the weakness of the former over this matter of principle. The outside local authorities honourably declined, in view of the decision of the House of Lords Committee in 1909, and the direction that they themselves thereby received, to be parties to the Salford offer that they should share in the spoils obtained from the gas consumers. Now the Corporation of Salford have fallen on to the path that should lead to a 1 per cent. limitation on the outstanding capital. They have proposed to the outside authorities that they shall consent to Salford taking from the gas

profits in relief of the rates £15,000, with an additional £2500 on the proposed new capital of £250,000. This limit, it is said, would be less than 2 per cent. on the aggregate capital expenditure of the Corporation. The outside authorities ought to stiffen their backs against two things in this proposal. One is the appropriation of a fixed sum, and the other the recognition of aggregate capital expenditure. A percentage, and that not more than 1, on the outstanding capital, and not the aggregate expenditure of capital, are the terms beyond which the outside authorities should refuse to budge. The strength of the position is with them; and not even the lachrymose plea that the Corporation are giving up by this offer £9000 per annum of the average amount which they took in relief of the rates during the ten years prior to 1909 should turn them. The Corporation having taken so much in the past, is a very good reason why they should be confined in future to the narrowest possible limits.

Without Gas.

Stalybridge has, for the best part of two nights and days, learned what it is to be without a gas supply; and the value of the supply, in street, house, and factory, must, through this untoward event, have gone up immensely in public estimation. It has been, we believe, a unique experience for the inhabitants. Gas supplies very rarely fail, unless it be due to strike or flood. Then the storage holders enable some warning to be given; and streets, railway stations, places of public assembly, shops, and private houses are not plunged with merciless suddenness into darkness. Stalybridge was not precipitately deprived of light, though the employees left the gas-works, and the lamplighters refused to perform their humble but useful functions. In this case, the municipal employees appear to have been making common cause for a betterment of their conditions of work. Whether they deserve better conditions or not, we have no means of judging. Anyway they took a very effective course, through participation by the gas workers, in enforcing a settlement. But what of the Conspiracy and Protection of Property Act of 1875? Is that not worth the paper it is printed on in a case like Stalybridge, when the municipal employees league themselves together to stop the public work and services of the town?

The Miracle at Gosport.

"The Miracle" at Olympia is creating some sensation; but Gosport is not going to allow Olympia to have it all its own way. As to Gosport, we should like to know first whether we are right in our figures; and then, if we are, there would be interest in learning how the miracle is performed there. In that town, the Council have gone in for some electric lighting in the streets; and, at a recent meeting, the Chairman who presides over the Committee in charge of the street lighting stated that—

> He had now received the report from the Electrical Engineer, who had tested the electric lamps in the public streets as to their illuminating power, which showed that the lamps "reputed" to give 120-candle power gave 126-candle power; and those "reputed" to give 300-candle power gave 380-candle power. The Committee are of opinion that the report is very satisfactory, and recommend same to the Council for adoption. . . The Electrical Engineer who tested the lamps was independent of the Company and the Council, and traded on his own account.

For interest sake, we should be pleased to be informed who was the Electrical Engineer referred to, what photometer he used in his tests, together with the circumstances under which the tests were made. If we had this information, it might make all the difference to the measure of our respect for the results obtained. The Chairman of the Committee does not appear from the report before us to have done the Electrical Engineer in question the honour of mentioning his name. If he did not, it was strange, as the name should have carried some weight in certifying the accuracy of the photometrical tests. However, the next point on which we should like to be informed is this: Are the lamps "reputed" to be of an illuminating power of 126 candles fitted with (each lantern) two 32-watt metallic filament lamps? Because, if so, some miracle must have happened to have enabled these lamps to produce 126-candle power. A 32-watt metallic filament lamp, when in good order, has an efficiency of 1¼ watts per candle power, and, in the photometer room, will give 25-candle power; two of them, 50-candle power. Now there is no reflector in the world that can increase the amount of light given by a source of light. Reflectors will direct the light where required; but they cannot multiply the light of the source by 2½. If they do, then something superhuman is at work in favour of these Gosport lamps. However, if we are incorrect in the nominal wattage of the lamps (32), then perhaps our criticism falls to the ground. If we are correct, then, technically, we cannot explain the phenomenon. It is a miracle, and beyond our poor human comprehension. The matter may be left at the one type of lamps. If the nominal and the reputed candle powers of the others are on the same lines, we should likewise be pleased to have some enlightenment regarding them. Will the Chairman of the Committee of the Council or the local Electrical Engineer explain what, within the limits of our information, is a mystery?

The Price of Gloom.

The "Evening Standard" has been considering the question of the weather effects on the London Gas and Electricity Companies; and the investigator finds that the Gas Companies being large suppliers of both light and heat, a gloomy and warm day in winter does not make itself felt on their output so much as it would do if it were gloomy and cold, or bright and cold. The Companies have no means of properly gauging the effect of different atmospherical conditions on different classes of consumption, in view of the fact that flat-rates for all domestic purposes only means one service and meter. But in the bulk they can tell the character of the atmospherical condition that serves them best. If they attempt to make comparison of a gloomy and warm day this year (say) with the corresponding day, according to the almanack, of last year, they find, as a rule, that atmospherical conditions come in to completely annul all congruity of circumstances. It may have been last year a cold and bright day or a warm and bright day. This shows how atmospherical conditions now help to keep the business on fairly level lines, without sharp flights upwards and sharp flights downwards. In the case of the electricity undertakings, on the other hand, the "Evening Standard" finds that days of gloom mean for some of the more important ones from 15 to 20 per cent. increased output, which shows that other atmospherical conditions—such as low temperatures—do not affect them much. The difference in charges for lighting and for such quantity of heating as they can boast of also enables some calculation to be made as to atmospheric effects on output.

American Views on Gasholder Guide-Framing.

The report which appears elsewhere of the proceedings at the inquiry into the circumstances connected with the unfortunate gasholder disaster at Ilkeston will probably cause many engineers and managers to give increased attention to the stability of the great receptacles upon which they have to depend for the storage of their gas. They have no doubt long had their own views on the merits of the various kinds of structures of this class now in use, but would probably not be averse to hearing those of an outsider. Such a desire, should it exist, can now be gratified; for, very opportunely, there has just come to hand, through an American contemporary, an article (on "The Guide-Framing of a Gasholder"), which is reproduced, with the diagrams accompanying it, in another part of the "JOURNAL." The author, Mr. E. F. Miller, is connected with the Camden (New Jersey) Iron-Works, and, after a short historical review, he deals in great detail with the subject of stresses, strains, and wind pressure. He classifies under six heads the various methods of guiding gasholders; and while acknowledging the economy effected by the adoption of the wire-rope and spiral-guided systems, he favours a steel frame with stiff diagonals and no horizontals, such as he shows in his views, as presenting a pleasing appearance accompanied by rigidity. He says the design has been developed as being economical in material, manufacture, and erection, and as giving satisfactory results at the least expense. He considers that, when gasholder guide-framing is designed according to the most approved practice, and made of suitable open-hearth steel, it is to be classed "among the safest examples of modern structural steelwork." Though the author's opinions on the various types of guide-framing may not be shared by engineers on this side the Atlantic, they are nevertheless worthy of consideration, as they are no doubt the result of personal experience.

The Consulting Elite.

Ridicule is being poured from all external quarters upon the new Association of Consulting Engineers, owing to the self-appraisement of the few who have met together to form them-

selves into an organization for mutual protection. A consulting engineer who is worthy the name can afford to hold himself aloof from any body starting off with the idea that the members must erect about themselves walls so high that it is impossible for a man talented as highly as any member, but who does not give up his whole time to consulting work, to climb over them. The absurdity of it all is obvious; and membership of the organization would be little better than a reproach to a man of position and individuality in the consulting world. We have spoken of the proposal before as being merely an attempt to create preserves for men in practice solely as consulting engineers who do not occupy official positions (nothing is said about directors); while, among the consultants, there are—more is the pity—to be found men who are not, in respect of technical training and engineering ability, worthy to walk in the same street with some men occupying official capacities. Another bar to membership has now been set up. The road to the new Association lies only through the Institution of Civil Engineers; and a candidate will stand no chance of election who is not a full member of that august body. However, if the list of those who have acquired the right to place M.Inst.C.E. after their names is glanced through, the wonder is, how some of them, for all their owners know about engineering, civil or otherwise, could ever have got there, except by patronizing influence. We should therefore be loth to accept membership of the Civils as representing any sufficient credentials as to a man's engineering ability. We really think out of self-respect some of those who previously determined to be members of the new body should withdraw their names. Membership will come to be recognized as the badge of inability by personal merit and ability to keep position in the consulting highways without the assistance of a sort of trades union.

The Position of Trade Unions.

There are to be found in Part C. of the Reports of the Chief Registrar of Friendly Societies for the twelve months to Dec. 31, 1910, some statistics which set forth the position of Trade Unions at the end of that year, as compared with 1909. Of course, all those bodies availing themselves of the advantages conferred by registration under the Trade Union Acts are required to furnish annually to the Registrar of Trade Unions (who is the Chief Registrar of Friendly Societies) a statement showing fully the assets and liabilities at Dec. 31 each year; the receipts and expenditure during the twelve months preceding that date; and, in regard to the latter item, separately the expenditure in respect of the several objects of the union. These returns have to be passed by auditors appointed as provided by the rules of the unions concerned; and they constitute the only returns of their financial transactions which registered trade unions are under any statutory obligation to furnish. At the close of the year 1910, there remained upon the register 669 trade unions; and of these, 638 supplied returns. The total membership for Great Britain and Ireland of the 638 unions was 2,017,656; their income amounted to £3,187,415, and their expenditure to £3,137,085; while the funds at the end of the year were £5,925,358. The figures for 1910, compared with those for the previous year, show an increase in membership of 59,752, or 3·052 per cent., an increase in income of £144,994, and a decrease in expenditure of £21,613. During 1910 the income of the unions exceeded the expenditure by £50,330. The average gross income per member was £1 11s. 7d.; and the amount of funds per member, £2 18s. 9d. In 1880, the number of returns was 156; in 1890, 235; in 1900, 661; in 1910, 638. In 1880, the number of members was 211,091, compared with the 2,017,656 in 1910; while in the same period the income went up from £240,448 to £3,187,415, and the balance of funds from £284,962 to £5,925,358. In the course of the year under review here, there were 28 trade unions registered. The list of unions includes, under London, the National Union of Gas Workers and General Labourers of Great Britain and Ireland, with a membership at the end of 1910 of 32,040; and in Birmingham, the Amalgamated Society of Gas Workers, Brickmakers, and General Labourers (membership 3805).

Organization on One Side

An appeal for unity is made by the Employers' Parliamentary Council, who, in an introduction to a report of their proceedings for the past year, point out that the events of the last session emphasize in a manner which is at once serious and significant the need for the closer co-operation of employers and employers' associations. Evidence in plenty is available in justification of the position taken up by the opponents of the Trade Disputes Act; and in this connection it may be recalled that some time ago the Council presented to the Prime Minister a memorial urging the need for legislation in regard to both picketing and trade unions. So far, it is not surprising to learn, nothing has happened as a result of this action; but the Council, even if not lighthearted, are not yet done with. They intend to persist in their demand that the Act shall be repealed, and that the labour unions, "privileged by its provisions to do wrong, shall be subjected to the ordinary law of the land, and made responsible, like all other classes of the community, for their actions." But if the demand is to succeed, and the industrial and trading interests of the country are to be properly protected, it will probably only, as the Council point out, be by a "united policy of firm determination and stern resistance on the part of employers as a class, supported by the intelligent section of their workpeople who fully realize that their own present and future welfare is bound up with that of their employers, and that whatever adversely affects the one as an economic consequence equally affects the other." At any rate, a plea is entered for one solid line of defence, instead of the formation of new federations and associations to agitate for the repeal of some measure or another; and there may, unfortunately, be only too much truth in the assertion that no single interest can now hope to fight its own battles with any chance of success. The Council will doubtless have some difficulty in securing what they are striving for—that each should come to the aid of all, so that all together may save each from destruction—but surely they will find that they have received a little help towards reaching their goal through the proceedings at the Labour Party Conference in Birmingham last week.

And on the Other.

That the employers' side of the struggle is likely to gain strength from what transpired at the Labour Party Conference must be evident to all but those who took part in the gathering. With the stereotyped resolutions that come up for consideration with more or less regularity at conferences of this character, there is no need to deal here. It is the Presidential Address of Mr. Ben Turner, delivered on the opening day, that appears likely to do at least as much good to his opponents as to his friends. The hope that it may be possible to arrange with the Irish party that Home Rule for Ireland and free rule for trade unions shall be part of next session's work in Parliament, may be left to the politicians; but the frankly socialistic tone of the remainder of the address will serve as some guide to those who are still in doubt as to the direction in which things are tending. It was stated that the industrial unrest of the past summer has borne its harvest in scores of thousands of men and women joining trade unions, socialist bodies, and local labour organizations; and the President added (what is clear enough) that the unrest still remains, and (what is not so clear) that it needs guiding into disciplined activity, and (what he terms) reasonable channels. The labour party is to show itself able to utilize the unrest further to solidify the forces of labour; and the railway strike is held up as a "grand sign of the growing solidarity of labour." In one thing, at any rate, we are inclined to agree with the President—that the lesson learned by the public through this strike is worth having the stoppage for. But possibly our understanding of this lesson is not altogether the same as that of Mr. Ben Turner. The insistence upon the Trade Disputes Act being maintained was natural at such a gathering; but, judging from the present state of affairs, there seems little need to urge its strengthening, "so as to prevent a man being victimized for his adherence to trade unionism." Recents events in Lancashire would appear to indicate rather that "the boot is on the other leg." If the President of the Labour Party Conference has accomplished nothing else, he has at least provided justification for the employers of labour taking "a hand in the game."

Reduction in Price by the Gaslight and Coke Company.—We learn from the Secretary (Mr. H. Rayner) that the Directors of the Gaslight and Coke Company have decided upon a reduction in the price of gas to 2s. 6d. per 1000 cubic feet in their district north of the Thames (excepting the Barking and Chigwell districts), as from the date of recording the meter indices for the past quarter.

PERSONAL.

Mr. RICHARD BERTRAM BROWN, who has recently returned from Chili, where he was Manager of the Iquique Gas-Works, has been selected as Manager of the South Barracas Gas-Works.

Mr. CHARLES V. BENNETT, Assistant Engineer and Manager of the Dartford Gas Company, and son of Mr. C. V. Bennett, the Manager of the Herne Bay Gas Company, Limited, has been gazetted second lieutenant in the Fifth Battalion of the Queen's Own (Royal West Kent Regiment).

Mr. A. E. JACKSON, Chief Engineering Assistant to the Manchester Corporation, has been selected, out of 123 applicants, as Borough Surveyor and Engineer of Southport; the commencing salary being £600 per annum, rising by annual increments of £50 to a maximum of £800. Mr. Jackson served his articles with Messrs. G. & G. H. Crowther, Water and Sewerage Engineers, of Huddersfield; leaving them to become Assistant to the City Surveyor and Water Engineer of Wakefield. He has been seven years with the Manchester Corporation.

In response to the advertisement which recently appeared in the "JOURNAL," there were 101 applicants for the position of Engineer and Works Manager of the Annfield Plain and District Gas Company, rendered vacant by the death of Mr. C. L. Ireland; and four of them were interviewed by the Directors. In the result, they selected Mr. THOMAS H. BEAUMONT, the Gas Manager of the Portland Urban District Council—a position which he has successfully filled for the past three years. Before going to Portland, Mr. Beaumont was Assistant-Manager at Huddersfield.

The officials of the Bristol Gas Company, to the number of about seventy, took supper together at the offices of the Company last week, under the presidency of the Secretary, Mr. John Phillips, who is also a Director. During the evening, the Chairman of the Company, Alderman J. W. S. DIX, who has occupied the position for the past twenty-one years, and has been a Director for about two years longer, was presented with a three-quarter length portrait of himself by Miss May Rivers. The presentation was made on behalf of the officials by Mr. Phillips; and Messrs. D. Irving (Engineer) and S. A. Ford (Collector) also spoke of the esteem in which Mr. Dix was held by the staff. Mr. Dix suitably acknowledged the gift.

OBITUARY.

The death took place last week of Mr. SAMUEL BERRY, a Director of the Barnstaple Gas Company. Deceased was an Alderman of the Town Council and a Justice of the Peace.

The Voelker Lighting Corporation, Limited, have lost a very valuable servant and a good friend by the death of Mr. W. E. FISHER, which took place on the 22nd inst., in his sixty-first year. He had been with the Company for more than seven years as their City representative, and had the supervision specially of their export trade. Mr. Fisher was formerly with the Wenham Gaslight Company. The funeral took place at Fulham New Cemetery, North Sheen, last Thursday.

We regret to announce the death last Tuesday, consequent on an operation, of Mr. HARRY BARBER, the Secretary and General Manager of the Sheppy Gas Company. After twenty-one years' service with the Portsea Island Gas Company, Mr. Barber went to Sheerness rather more than fourteen years ago, to take the above-named position in succession to the late Mr. A. W. Marks. He proved a very capable and trustworthy officer, enjoying the confidence alike of Directors, shareholders, and consumers; and his death will be a great loss to the Company and to the town generally. His quiet, unobtrusive manner, combined with his courtesy and keen business habits, and his consideration for the interest of the Company and the consumers, gained for him the respect and esteem of all who knew him. The funeral was fixed to take place last Saturday afternoon, at the Isle of Sheppy Cemetery. Mr. Barber, who had recently entered his fifty-first year, leaves a widow.

South Metropolitan Gas Company's Dividend.—The Directors of the South Metropolitan Gas Company will recommend a statutory dividend for the half year ended the 31st ult. at the rate of £5 9s. 4d. per cent. per annum; carrying forward £125,976 compared with the carry-forward of £85,209 twelve months ago.

Manchester and District Junior Gas Association.—By the courtesy of Mr. H. Kendrick, the Engineer and Manager, the members of the Association will inspect the Stretford Gas-Works next Saturday afternoon. At the close of the inspection, the visitors will be invited to take tea, provided by Mr. Kendrick, in the general office. After tea, a coffee meeting will be held at Gorse Hill Hotel, and Mr. J. Bridge, the Assistant-Manager of the gas-works, will open a discussion on "Purification."

Slip of Water-Meters.—This was tested last year in connection with a water-waste survey of portions of the city of Milwaukee made by the city's Bureau of Economy and Efficiency under the direction of Mr. Ray Palmer. The results obtained from various tests on meters of about ¾ inch average size showed the average slip for 3431 meters of the piston type to be 3·15 per cent., and for 1955 disc meters 0·6 per cent. A mean value for slip of meters, based on these results, would be between 1½ and 2 per cent.

ELECTRICITY SUPPLY MEMORANDA.

The Electrical Measure of the Loss in Cooking Meat in the Gas-Oven—Water Evaporation or Solid Meat—A New Term in the "Electrical Times" Vocabulary—A Surprise for the "Electrical Review"—Domestic Heating—Public Lighting.

THERE are signs that some of our electrical friends are beginning to realize the absurdity of attaching to the loss of the weight of meat in cooking the original value put upon it by the butcher, as though the water evaporated was solid meat. Mr. G. A. Allingham, Assoc.M.Inst.E.E., has called attention to this matter in the columns of at least three of our electrical contemporaries, and maybe others that we have not yet seen. He remarks that it has "frequently" been stated that meat, when roasted in an electric oven, loses only about 10 per cent. in weight, as compared with a loss of about 30 per cent. when cooked in a gas or coal heated oven. We are pleased that Mr. Allingham uses the word "frequently," and gives the loss as "about" 30 per cent. in a gas-heated oven, because the word "frequently" confirms our view as to the extravagant flights that electrical fancy is taking in this matter; and the "about" helps to save the situation where the statement as to loss is made without any reference to the character of the meat, or the methods by which it is cooked. Our comments in last week's "Memoranda" showed that it is as easy to cook a joint similar in weight and character, in an enclosed baking-tin in a gas-oven, without any great loss of weight through evaporation, as in an electric oven. But the loss of weight business is growing on our electrical friends, as witness the "frequently" and the "30 per cent." We see in another paper that an electricity cooking advocate places the loss of meat by all the so-called barbarous methods employed at 20 per cent.; and in the "Electrical Times," "Meteor" tells his readers that "Food and Cookery, and the Catering World" (he describes it as this "little caterer's" journal) puts the loss of shrinkage and evaporation of "meat juices" at 6 per cent. for the electric oven compared with other forms of cooking, "*which*" lose 18 to 20 per cent. in the weight of meat. It is a trifle that "Meteor," in his supreme care for accuracy, omits to tell his readers, that, under the heading of the note from which he takes this statement, the significant word "Contributed" appears. "Contributed" by whom? However, it is seen that the electricians have not yet arrived at a state of agreement as to the amount of loss of "meat" they shall ascribe to either the electric oven or the popular practice of cooking in gas-ovens.

Mr. Allingham proceeds to make the following commonsense observations: "But does that mean that 30 per cent. of the actual meat disappears? Is it not almost entirely water which evaporates? Surely no appreciable amount of the nutritive substances in the meat vanishes into thin air!—a small quantity of the juices may run out of the meat, but that would only represent a very small fraction of 30 per cent. of its weight, and would, moreover, be saved. If my supposition is correct, I fail to see where the saving of meat due to cooking by electricity comes in, for the only effect of cooking by the older methods is that the meat is obtained in a more concentrated condition, and a correspondingly smaller quantity of it should be needed to satisfy the appetite." Upon this the "Electrician" remarks that it does not agree with its correspondent; for it is generally recognized that the goodness of cooked meat is not in proportion to its desiccation. A sapient remark that does not dispose of Mr. Allingham's main point! "Desiccation" is a new word in the vocabulary of the "Electrical Times." In an airy note to Mr. Allingham's letter in that paper, dealing with beef-steaks, the *genus homo*, melons, marrows, cucumbers, cocoanuts, and other incongruities, we find the writer speaking of a beef-steak being "dessicated," and if we only "dessicate" sufficiently, &c. And in a note by "Meteor," earlier in the paper, we have the "dessication" process spoken of; and something about lamb and mutton which "dessicated" less easily. The subject of desiccation and the term are evidently altogether new to "Meteor." He tells some queer story about a lady who could not cook beef in a gas-oven, owing to the "dessication" process. That lady does not know how to properly use a gas-oven; but the curious part is that she can cook lamb and mutton in a gas-stove, because they are "dessicated" less easily. "Dear 'Meteor,' do be sensible. You add to the joys of life by your writings; but do not give way to exaggeration." Joints of beef that "Meteor" has enjoyed have been cooked in gas-ovens. Beef that we have enjoyed has been cooked for many years in gas-stoves, and without the drying up and toughening of which he speaks. There are cooks and cooks; there is cooking and cooking; there are temperatures and temperatures; and there are right and wrong ways of cooking. Some people like under-done meat; some well-done. The human factor indeed comes very prominently into cooking. There are ways and means (our friend Mr. Seabrook has found out one method) of cooking in gas-stoves by which the juices of meat can be retained equally with any other form of cooking. Had it been otherwise, with 3 million gas-cookers in use in the country, and every stove used for baking the meat of more than one person, the whole country ought, electrically speaking, to be suffering now from acute dyspepsia; and the medical profession ought to be above caring anything for Mr. Lloyd George and the Insurance Bill.

The "Electrical Review" has had a special leading article on "Electric Cooking and Heating." All the electrical papers are enthusiastic over the subject. The "Review" profoundly states

what we believe is not altogether new information, that cooking and heating are universal. Therefore, "all that is required is to divert the trade from coal and gas to electricity—not to create a new want, as in the case of domestic power." There is only one thing—so we understand our contemporary—that projects itself in the path of the diversion process, and that is the high price of electric cookers, combined with the fact that hire terms have not yet become feasible in the electric-supply industry. As recent articles in the "JOURNAL" have shown, there are, in our judgment, some few other obstacles to the universal displacement of the gas-cooker by the electric-cooker, altogether separate from the low thermal value of a unit of electricity. In another editorial article, the "Review" deals with Mr. Allingham's letter; and we are not a little astonished to read part of this statement: "No one, we think, has ever suggested that the wastage represents the disappearance of solid meat; such matter is neither soluble nor volatile, and we have always understood that the loss in weight must be due almost wholly to evaporation. We should be very much surprised to find that any other view was held or advocated." What has the "Review" been doing during all the recent campaign to arouse interest in electrical cooking. Has it really not heard the loss in weight during the subjecting of meat to cooking temperatures referred to as loss of "meat," and has it not seen the loss weighed up at the price charged per pound by the butcher? It was not long since that Mr. Seabrook was saying that "users of electric cookers are rapidly realizing that the saving in the butcher's bill is sufficient to pay the cost of electric cooking." In a letter by a "Tricity" cooker advocate recently published by the "Electrician," the writer worked out a difference in the cooking of a joint by electricity and gas, so that he showed "a saving in favour of electricity equal to 15 oz. of meat, worth (say) 11d." [By the way, the writer of that letter has not sent us a reply to the questions put to him in the "Memoranda" last week.] Then we have a table in the new leaflet of the Electricity Publicity Committee, with savings in weight worked out at 10d. per pound! The surprise of the "Review" ought now to know no bounds; and it ought to soundly rate those electricians who represent evaporation as meat, and compute it at the butcher's price for the raw substance. It might at the same time suggest to them the propriety of furnishing us with information on other questions upon which we have been unable as yet to draw a single electrician—such as a description of the gas-stoves used in the tests that it is alleged have been instituted, and details as to a few other matters to which reference has been made by us in dealing with this subject—in last week's "Memoranda" and previously. Their reticence on the subject is perhaps understandable. However, although the obvious point has been raised by us before as to the misleading statement in calling "evaporation" "meat," and as to the absurdity of pricing it out at the charge for raw meat, the electrical papers do not appear to be altogether pleased that an electrician has pointedly drawn attention to the folly in their own columns.

The last two issues of the "Electrical Times" are more than usually alive and interesting in matters that have association with the commercial competition. Articles on "Electric Heating and Cooking" are appearing by "A Domestic User," whose knowledge of electrical matters shows that the electrical apparatus within the limits of his suburban residence is run under the best of conditions, and with all the attention and tenderness that an expert nurse can render. He states that, at 1½d. per unit on a flat-rate, the cost of heating every room and passage in a draughty modern house throughout the winter is admittedly heavier than that by gas or coal. No one in his right senses will dispute that. But there is qualification by this expert "Domestic User." "The cost," he says, "worked out to so many units does not, of course, represent a fair basis of comparison. Due allowance must be made for the many advantages; the most obvious being the saving of labour, and freedom from dust or dirt." As all these savings are effected by gas heating, and the cost of gas heating is lighter than electricity, naturally gas wins as the more economical agent for this purpose. But "Domestic User" spoils his article by inserting a side shaft asserting that where gas is employed for heating, "it is necessary to open windows so as to neutralize, *as far as possible*, by brisk air circulation the pollution of the atmosphere." That is stepping off the path of veracity. Scientific tests at the Leeds University and in other quarters with modern gas-fires had, we thought, long since laid this electrical phantom to rest, quite apart from public experience and the winter-by-winter growing popularity that makes low atmospheric temperature a matter of great importance to gas undertakings.

But we turn to the cost of heating by electricity. "Domestic User" gives some temperature and consumption figures for the heating of four rooms only in his ten-roomed house. In his illustration he raises the temperature from only about 48° or 50° Fahr. to 60° Fahr., and then maintains this temperature or thereabouts. The consumptions, as we read the table, are for the first five hours in room "A," 1450 watts per hour; in room "B," 1800 watts per hour; in room "C," 1000 watts per hour; and in room "D," 1400 watts per hour. If these hourly consumptions are multiplied by five, we get a total of 28,250 watts Supposing the four rooms required warming for fourteen hours a day in the depth of winter. Then, as we read the table, during the remaining nine hours, in room "A" 750 watts per hour would be required to maintain the temperature at 60° Fahr., in room "B" 1000 watts per hour, in room "C" 1000 watts per hour, and in room "D" 900 watts per hour. Multiplying these figures by nine hours, and totalling them, the maintenance of temperature would represent a further consumption of 32,850 watts; so that fourteen hours' consumption in four rooms would represent upwards of 61 units, which, at 1½d. per unit, represents 7s. 7½d. for the fourteen hours, and allowing nothing for the other six rooms in the house. We do not suppose in a ten-roomed house, that the householder would keep four rooms warmed continuously during the whole fourteen hours. But there is a servant. She cannot do without warmth in winter. There are the wife and two children; and they require warmth wherever they may be. There is also "Domestic User"—the head of the family. When we come to consider this little domestic circle, a good many hours' heating a day in the depth of winter would be totalled up by the various rooms in the house that are brought into use, if comfort and health are studied. We can do better than this householder in the matter of temperature with a room about the same size as the largest he mentions—16 ft. by 13 ft. 6 in. by 9 ft. 3 in. high—with a modern gas-fire fitted with a duplex tap, and using, full on, the first hour 25 cubic feet of gas, and afterwards about 12½ feet per hour. "Domestic User" also complains of the glare in the earlier part of the life of the radiation bulbs. He also finds 800 burning hours are much above the average limit of life. Long before such an age has been reached, his experience is that the lamps have ceased to glow with any brilliance, that they have a very dead-and-alive appearance, and give out an increasing percentage of convected heat. At 4s. each bulb, the renewal bill soon assumes substantial proportions. Therefore, before entering upon the heating of a house throughout with electric-radiators, one must take the precaution of being a millionaire.

Leaving "Domestic User" for the present, there are some notes by "Meteor" in this week's issue of the same paper on the subject of street lighting, the provoking cause of the notes being a contest at Aberdeen between the Gas and Electrical Engineers. "Meteor" has to go far afield to give support—and that very weak support—to the Aberdeen Electrical Engineer. "Meteor" states that gas is falling into disuse on the Continent and in America. Will "Meteor" kindly modernize his knowledge by reading the Glasgow report upon what is being done in Berlin. He will find it in last week's issue of the "JOURNAL." Perhaps, too, he will favour us by reading the editorial article in the previous week's issue, with the official statistics in later columns, regarding the lighting of Westminster. He also refers to a tender in the far-off provincial town of Lewes. Cannot he find something just a little more apposite. Then he quotes public lighting statistics compiled some time since by Mr. Tomlinson-Lee, of Wimbledon. These statistics were criticized in our columns at the time, and in more issues than one. Care was taken to bring the criticisms to the notice of Mr. Tomlinson-Lee. Will "Meteor" kindly ask that gentleman why he did not notice the criticisms at the time, and try to prevail upon him to take the matter up now? We could not succeed in getting him to come forward. Perhaps "Meteor" will be more successful. Our columns are still open to him. With reference to an allusion to M. Grebel, cannot "Meteor" stay in this country? The statements made by M. Grebel as to the inverted gas-burner are not endorsed by home experience. And as to the mention of Mr. S. B. Langlands, whom "Meteor" has consistently kept in stock for street-lighting purposes since the meeting of the Institution of Gas Engineers in June last, that gentleman's statement was discounted at the time he made it. Since then Mr. Langlands has been to other cities not to hear what gas engineers are doing, but to see what is actually being accomplished; and a scheme of high-pressure gas lighting is now before the Glasgow City Council!

Mr. M'Lusky's Successor at Perth.

Of the number of candidates for the appointment of Gas Engineer and Manager to the Corporation of Perth, in succession to Mr. W. B. M'Lusky, who, as already announced in the "JOURNAL," has been selected by the Halifax Corporation to fill the position vacated by Mr. John Wilkinson, three were indicated as being the most suitable; and they were interviewed by the Town Council at a special meeting last Thursday. A ballot was taken, with the result that Mr. David Vass, of Airdrie, was successful; he having secured three votes more than the next highest candidate. After having completed his preparatory training for his profession, Mr. Vass entered the service of the Greenock Corporation Gas Department in 1877, and was afterwards transferred to the works as Assistant to the late Mr. Samuel Stewart. He received in 1887 his first appointment as Manager and Secretary to the Portobello Gas Company; and when there he carried out several extensions of plant, including the erection of the first steel gasholder tank in Scotland. As Secretary, he remodelled the book-keeping of the Company, and also assisted in the transfer of the Company to the Corporation of Edinburgh. After this business was completed, he was retained by the Edinburgh and Leith Corporations Gas Commissioners as Resident Engineer and District Superintendent, which position he resigned on receiving the offer of the appointment of Engineer and Manager at Airdrie. There he has remodelled the works, and practically doubled the producing plant. Mr. Vass presided at the Informal Meeting of Scottish Gas Managers, held in the spring of 1909, and again in 1910. He is a member of the Institution of Gas Engineers and of the North British Association—being at present Chairman of the Commercial Section (Western Division) of the latter body—and a Past-President of the Waverley Association.

GAS BILLS FOR 1912.

[Fourth Article.]

The Bills that form the subject of this section of the review are those promoted by local authorities. Some of them deal exclusively with gas matters; others only partially. The Askam and District Gas Bill, of which notice was given last November, has been dropped.

The Bill of the Ashborne District Council first claims notice, taking the measures in their alphabetical order. It incorporates a scheme for the purchase of the local gas undertaking; the proposal being consequent upon the insertion of a purchase clause in the Company's Act of last session, and which clause is only operative in the coming session. The purchase clause is in usual terms, and provides for purchase by agreement or arbitration. If, by arbitration, the Arbitrator or the Umpire (it is proposed) is not, in assessing the amount to be paid to the Company, to have regard to the fact that the Company obtained an Act in 1911, but shall fix the amount to be paid as if the Act had not been passed. But if the present Bill succeeds, the Council are to pay the Company the costs incidental to the obtaining of the 1911 Act. There are the ordinary provisions as to valuation of stocks, and the payment of compensation to officers who are not retained in the service. The limits of supply specified include the district of Ashborne, and the parishes of Clifton and Compton, Mappleton, Offcote, and Underwood and Sturston, and the parishes of Mayfield and Okeover. Provision is made for the sale to, and the purchase by, outside authorities of portions of the distribution plant in their areas. It is proposed that the price of gas in Ashborne shall not at any time exceed 3s. 4d., and beyond the urban district 3s. 10d. per 1000 cubic feet. The Council are providing for discounts not exceeding in any case 25 per cent. to consumers of gas in consideration of prompt payment or of large consumption, or in respect of gas supplied by contract or for motive power. A stand-by clause appears in respect of gas supply. With regard to financial matters, the Council ask power to borrow the amount required for purchase, compensation, and expenses incidental to the purchase and winding-up of the undertaking, and, under the sanction of the Local Government Board, any sums required for the extension and improvement of the plant. For the money borrowed in connection with the purchase, it is asked that the period of repayment may be forty years. [*Parliamentary Agents: Messrs. Dyson and Co.*]

The District Council of Bedwellty are forward with a Bill for making provision in regard to the local government and improvement of their district, and, among other important proposals, they desire to be authorized to supply gas and water, and to purchase certain gas and water concerns. Only their plans relating to gas supply are dealt with here. Generally, it is contemplated that the New Tredegar Gas and Water Company's property and business shall be transferred to the Council, that the undertaking of the Blackwood Gas Company shall be purchased, that the present promoters be authorized to sell so much of the Blackwood undertaking as is situate within the district of Mynyddislwyn to the local Council, and that the Council be authorized to purchase so much of the water undertaking of the Rhymney and Aber Valleys Gas and Water Company as is situated within the proposed limits of supply. It will be remembered that a Bill on somewhat similar lines was introduced for promotion last session, but was dropped for the time being. The same agreement with the New Tredegar Gas and Water Company stands as the first schedule. In it the date of the transfer was named as Aug. 15, 1911; but a subsequent clause provides that Aug. 15, 1912, shall be the date, in the event of the Royal Assent not being obtained during 1911. The consideration to be paid to the Company is £23,415 in cash. The Company are not to allow the stores to run below the value of £200, and the stores beyond that value are to be paid for. Provisions in the Rhymney and Aber Valleys Water Act, 1898, relating to the New Tredegar Company, it is intended shall be construed as referring to the Bedwellty Council. The Blackwood purchase is to be by agreement or arbitration; and the sale (previously alluded to) of part of the Blackwood undertaking to the Mynyddislwyn Council is proposed to be within twelve months after Aug. 16, 1929, or after any earlier day that may be agreed upon—subject to purchase powers being obtained; the sale being either by agreement or arbitration. Passing for the time being over the water clauses, the district of supply is defined as the district of the Council (except so much thereof as is comprised within the limits of supply of gas of the Rhymney Company, and within which the Company now supply gas), part of the urban district of Gelligaer, and the part of Mynyddislwyn within the area of supply of the Blackwood Company. But it is stipulated that the Council are not to supply within the limits of this Company without their consent, or until the transfer of the undertaking. All the necessary powers for carrying on the gas business are sought. It is specified that the price of gas is not to exceed 6s. per 1000 cubic feet. The illuminating power of the gas, it is asked, shall be prescribed at 14 candles, as tested by the "Metropolitan" No. 2 burner. The Council request power to borrow the requisite amounts for the purchase of the various undertakings; the period wanted for repayment being 45 years. Any other money required, it is suggested, shall be borrowed with the sanction of the Local Government Board. Separate gas and water accounts are provided for. [*Parliamentary Agents: Messrs. Baker and Co.*]

Owing to the increase in the demand for gas, the Belfast Corporation have been giving serious attention to the question of the extension of the gas-works; and they are now promoting a Bill to authorize them to acquire and to use for the purpose of the gas undertaking certain lands adjoining and in proximity to the existing works. An estimate has been prepared of the cost of constructing the works contemplated by the Bill, including the sum necessary for the purchase of the lands required; and it amounts to £400,000. The lands that the Corporation desire to take for manufacturing purposes are shown in the schedules to the Bill. In connection with these lands, two bridges are proposed over the River Blackstaff; and the right to stop up certain minor streets and places on the new site is sought. Conditions are inserted in relation to the displacing of persons of the working class. Among other matters dealt with is the illuminating power of gas and its testing. It is proposed to repeal the prescriptions of sections 60 and 62 of the Act of 1874; and to substitute a standard of 14 candles and the "Metropolitan" No. 2 burner. Stand-by clauses referring to both gas and electricity are included in the Bill. The Corporation ask for powers to borrow, in respect of the works authorized and the purchase of lands, any sums not exceeding £400,000. It is proposed that the money to be spent on lands shall be repaid in sixty years, and on gas-works within a period not exceeding forty years. [*Parliamentary Agents: Messrs. Dyson and Co.*]

The Birmingham Corporation are also up for land powers for gas-manufacturing purposes; and the description suggests that the proposed land makes a very eligible site for the purpose. It measures 36 acres 3 roods 26 perches, or thereabouts, and is bounded on the north-west and north by the River Rea and works, on the south-east by the sidings of the Midland Railway Company, on the south-west by the embankment and works of the London and North-Western (Aston and Stechford Branch) Railway, and on the west by the access road belonging to the Birmingham, Tame, and Rea District Drainage Board. [*Parliamentary Agents: Messrs. Sharpe, Pritchard, and Co.*]

Another Purchase Bill is that of the Cannock District Council; the object of acquisition being the undertaking of the Cannock, Hednesford, and District Gas Company. In the Company's Order of last year, there is a clause providing for this application to Parliament, and for the sale at £72,000, and such further sum as may be necessary to pay dividends upon the capital from the time of the previous payment of dividends to the date of transfer. The passing of ownership will take place on Dec. 31 next, or other agreed date. Within the limits in which the Company are authorized to supply gas, and within the area of the Ogley Hay and Brownhills Gas Company, Limited, there is a part of the parish of Norton-under-Cannock, to the south and west of the Birmingham Canal, which, it is said, can be more conveniently supplied with gas by the Council than by the Brownhills Company, and which the Brownhills District Council desire that the Cannock Council should supply. The necessary power is sought. Estimates for works extension and improvement amount to £45,000. There is nothing special about the purchase clauses of the measure. The limits of supply are to be the urban district of Cannock, Cheslyn Hay, Great Wyrley, the part of the parish of Norton-under-Cannock known as Norton Canes in the urban district of Brownhills, Shareshill, Saredon, Hatherton, Huntingdon, and the Hazleslade ward of the parish of Brereton. Works construction, gas manufacture, and road diversion powers are provided for. The price charged for gas is not to exceed 4s. 6d. per 1000 cubic feet for gas of a standard illuminating power of 14 candles, as tested by the Metropolitan No. 2 burner. Provision is made for the laying of mains in any street within the limits of supply, upon the receipt of a requisition in writing of the local or road authority (other than the Council), or of any owner or occupier, and for entering into a written contract for five years to take a supply of gas to an amount that shall return rents or rates to the equivalent of 10 per cent. upon the sum expended in laying down the main. In clauses for the protection of local and road authorities, it is provided that, if reasonably possible, pipes shall be laid or constructed at a depth so that not less than 2 ft. 6 in. intervenes between the road surface and the upper surface of such mains, pipes, or works; but if steel mains are laid instead of cast-iron ones, the depth need not exceed 2 feet. Protecting clauses are given to the London and North-Western Railway Company, to the proprietors of the Birmingham Canal Navigation, and to the owners of minerals. One of the succeeding clauses is to repeal the Brownhills Gas Order of 1910, so far as it relates to the supply of part of the parish of Norton-under Cannock. Power is sought to borrow the purchase money, and £45,000 for works extension and improvement; the periods of repayment desired being respectively fifty and forty years. [*Parliamentary Agents: Messrs. Smiles and Co.*]

There has been no official intimation yet that the Salford Corporation Gas Bill has been withdrawn in favour of the Provisional Order of which we recently heard. The Bill is one for the extension of the gas-works; and the estimates contemplate the expenditure of £250,000. The lands over which the Corporation desire manufacturing power comprise the Earl of Ellesmere's brickworks, which are bounded by Liverpool Street, West Egerton Street, the London and North-Western Railway, and in part by the Liverpool Street Wharf. Power is taken to obtain access from the described lands to the adjacent railways. The prescribed

illuminating power, it is proposed, shall be 14 candles, tested by the "Metropolitan" No. 2 burner. It is also contemplated that—

The provisions of section 94 (power to let meters) of the Act of 1862 shall be extended, so as to enable the Corporation to recover summarily as a civil debt remuneration for, and in respect of, work done by the Corporation at the request of the hirer in the fixing and repairing of gas stoves and fittings and apparatus connected therewith, as well as remuneration for the hire of such gas stoves, fittings, and apparatus; and the provision of section 25 (Corporation may provide electrical apparatus, &c.) of the Act of 1900 shall be amended, so as to enable the Corporation to recover summarily as a civil debt remuneration payable to the Corporation thereunder, and remuneration payable to them for, and in respect of, work done by the Corporation at the request of the hirer in the fixing and repairing of electric motors and apparatus.

The Corporation ask power to borrow £250,000, repayable in thirty years. [*Parliamentary Agents: Messrs. Dyson and Co.*]

Now we come to the Bill promoted by the Eccles Corporation and the District Councils of Swinton and Pendlebury and Worsley, and which Bill is not favourably regarded by the Salford Corporation and many other authorities who appropriate gas profits in aid of the rates. The Salford Corporation supply gas in the borough of Eccles and the urban districts of Swinton and Pendlebury and Worsley, as well as other parishes; and the governing authorities of these areas have promoted this Bill "to make further provision in regard to the application of the revenue arising from the gas undertaking of the Mayor, Aldermen, and Burgesses of the County Borough of Salford, and to confer further powers on that Corporation in regard to the said undertaking, and for other purposes." In the preamble of the Bill, the circumstances are detailed under which the measure is now being promoted. In 1909, the Salford Corporation introduced a Bill for the purposes proposed in the one again submitted this year. The Bill was opposed by the Eccles, Swinton and Pendlebury, Worsley, and Barton-upon-Irwell authorities. There was a protracted hearing by a Committee of the House of Lords, who "determined to insert provisions in the Bill for the purpose of prohibiting the Corporation from continuing to apply large sums derived from the profits of the gas undertaking in aid of the rates of the borough, and for the purpose of prescribing the manner in which the revenue of the gas undertaking should be applied, and in particular requiring the surplus revenue to be applied in the reduction of the price of gas supplied by the Corporation." In consequence of this decision of the Select Committee, the Corporation withdrew the Bill. Now it is submitted that it is expedient that statutory effect should be given to the decision of the Committee of the House of Lords on the Bill of 1909. So far as the land, works, illuminating power, and testing provisions are concerned, they are the same as those already mentioned in dealing with the Salford Bill. The first additional clause provides for free burners of the flat-flame type, suitable for gas of the illuminating power of 14 candles, being supplied to consumers requiring them within two years after the passing of the Act. The financial regulations follow. It is proposed that it be provided that, from March 31 this year, the gas revenue shall be applied: (1) In payment of the working and establishment expenses and cost of maintenance, renewal, and repair of the undertaking; (2) in payment of interest on moneys borrowed and reborrowed; (3) in providing the requisite appropriations, instalments, or sinking fund payments; (4) in repayment to the district fund of any deficiency in the revenue of the Corporation in respect of the gas undertaking at any time hereafter made good out of the fund; (5) in, if thought fit, providing a reserve fund by yearly appropriations of ½ per cent. upon the outstanding loans, with a maximum accumulation of 10 per cent. of the moneys outstanding; (6) in setting apart a yearly sum equal to 1 per cent. per annum upon the amount of the outstanding loans, after deducting all sums repaid and all sums standing to the credit of any sinking fund, which sum shall be carried to the credit of the district fund of the borough. The residue is to be carried forward to the revenue account; and whenever the amount exceeds the sums required to meet the purposes Nos. 2, 3, and 6, it is proposed that it be applied to the reduction of the price of gas. Any deficiency, it is suggested, shall be made good, in the first instance, out of the reserve fund (if any); and in the event of its insufficiency, out of the district fund of the borough; but such debt, it is provided, shall be repaid out of future revenue. It is contemplated that the existing depreciation fund or reserve fund shall form part of the reserve fund the Corporation are to be authorized to form by the Bill. Any disputes over these matters are to be referred to the Local Government Board. Another clause contemplates that, as from Sept. 30, 1912, the Corporation are not to charge a greater price, rent, or rate for gas supplied by them to consumers of gas, or for public lighting, in Worsley and the rural district of Barton-upon-Irwell than that which they charge in respect of gas supplied by them to consumers of gas, in similar circumstances or credit, for the supply of gas for the purpose of public lighting within the borough. Then it is proposed that the Corporation shall in each year credit the revenue account of the gas undertaking with an amount for the gas consumed for public purposes calculated at the rates charged to private consumers, which amount shall be a charge upon the rates leviable for public lighting. The present promoters desire also to provide for a very remote contingency. Should the undertaking, through the discontinuance of the use of gas, become a total loss, and the outstanding capital should thus become chargeable upon the rates, the Corporation of Eccles, the District Councils of Swinton and Pendlebury and Worsley, and the Rural District Council of Barton-upon-Irwell are, it is proposed, to repay to the Corporation the proportion of the moneys so chargeable which the rateable value of the outside districts concerned bears to the total rateable value of the borough. Then follow the clauses as to borrowing powers on the lines of those noticed in the reference to the Salford Corporation Bill. The final clause proposes that the expense of the measure shall be paid by the Corporation of Salford out of the borough fund, or out of moneys to be borrowed by them for the purposes of the Bill if it passes. [*Parliamentary Agents: Messrs. Sharpe, Pritchard, and Co.*]

The Shipley District Council Act in greater part refers to water supply. In regard to the gas undertaking, it is proposed that the standard illuminating power be 14 candles, as tested by the "Metropolitan" No. 2 burner. Sections 35 (Quality of gas) and 36 (Test-meters to be erected) of the Act of 1870 are intended to be repealed. A stand-by clause relating to private gas supplies is included in the Bill. Other clauses are of the stereotyped form, including the prepayment meter one, except that there is an extension of the meter-without-fittings provision. The hire, it is suggested, shall be at the rate of 6d. per 1000 cubic feet; and the provisions of this Act and the Acts of 1870 and 1901 applicable to ordinary meters shall, so far as applicable, apply to prepayment meters. [*Parliamentary Agents: Messrs. Lees and Co.*]

Under a purchase clause inserted in the Sidmouth Gas and Electricity Company's Bill last session, the District Council are promoting a Bill for becoming the owners of the property and business of the Company. The limits of supply for both gas and electricity, it is proposed, shall be the urban district of Sidmouth and the parishes of Salcombe Regis and Sidbury. Purchase is to be by agreement or arbitration; and the Council are binding themselves to give notice of their intention to purchase within six months of the passing of the Act. As Director or Managing Director of the Company, Mr. Thomas Douglas is to be compensated; and provision is also made for the compensation of other officers who comply with the conditions laid down. Gas manufacturing and electricity generating powers are included. The price of gas is limited to 4s. 6d. per 1000 cubic feet, A stand-by clause is inserted relating to premises having a separate supply of gas or electricity. The Council ask permission to borrow the money necessary for the purchase, and such other sums as the Local Government Board may allow. The repayment period desired for the purchase money is forty years. [*Parliamentary Agents: Messrs. Baker and Co.*]

PHOTOMETRY AND LIGHT MEASUREMENT.

Lecture by Mr. A. C. Jolley.

As announced in the "JOURNAL" a fortnight ago, the work of the present session at the Northampton Polytechnic Institute, St. John Street, E.C., is to include a course of ten lectures on "Illuminating Engineering," each to be given by a specialist in the particular subject dealt with. The first of the series was by Mr. S. D. Chalmers, M.A., on the "Nature of Light and of Radiation;" and the second (which was delivered last Tuesday evening) was by Mr. A. C. Jolley, on "Photometry and the Measurement of Light." Mr. Jolley's remarks, which occupied more than an hour-and-a-half, were illustrated by a number of lantern views and a great many of the instruments to which he made reference; and he certainly deserved a larger audience than that which assembled to hear him.

In opening, the lecturer pointed out the difficulty of compressing into one short lecture a comprehensive digest of the large amount of work that has been done during recent years in connection with photometry, and said that anything he put before them must be looked upon as a mere cursory glance at, or sketch of, the subject. The first function of vision was the perception of light and shade; the next, the discernment of detail; and the third, the perception of colour—which was quite a different thing. They were all physiological, and consequently were in the nature of abstract things. The first unit of importance was the unit of intensity; and in this country and many others this was expressed as the candle power of the source. A great deal of controversy had arisen over the desirability of retaining the candle, and the suggestions that had been made to substitute others; but, on the whole, he was inclined to believe that the term "candle power" was a good one, for it certainly did convey to the layman some idea of the magnitude of a quantity, as he was perfectly well acquainted with the candle.

The modern light standards might be divided into two great groups. The first embraced the incandescent standards, in which a scientific effort had been made to standardize the amount of light that was radiated from a certain definite surface of a material kept at a definite temperature. The second group—*i.e.*, flame standards—aimed at the production of a flame from a fuel of definite composition, in a burner of definite dimensions, at a definite rate. As regarded the first, it would seem, on the face of it, that all that was necessary to realize a satisfactory standard was to take an area of a definite material and keep it at a definite temperature. But there were great obstacles in the way. The area was no trouble; but, on the other hand, there was enormous difficulty about the determination of the temperature. The use of platinum in various ways had been resorted to; and another

suggestion—made both by Mr. Swinburne and Professor Thompson—was to employ a definite area of the open carbon arc. The latter idea had been investigated; but it was shown that the crater of the arc was not necessarily uniform in its radiant properties, though it would appear from theory that the temperature of the arc crater should be uniform. Apart from these incandescent standards, there was only one other that could be considered at all practicable. It was to use the radiation from 1 square millimetre of a black body at 2000° C. With this, the main difficulty was to get a substance which would withstand the temperature named, and in settling the temperature when they had got it. The other group—the flame standards—were far more common, and were in daily use. There were, however, difficulties here also. A flame, of course, depended upon the atmosphere for its existence; so that all flame standards were necessarily affected by the height of the barometer and the amount of carbonic acid and of water-vapour present. Every flame standard must be corrected for these matters; and it was not easy.

The oldest flame standard, continued Mr. Jolley, was the French carcel burning a stated quantity of purified rapeseed oil. This had its drawbacks; but it had undoubtedly done good work in the hands of many of the best French experimenters. The next lamp (also of Continental origin) was the amyl-acetate Hefner lamp, the one great advantage of which was to be found in the fact that the whole of its constants had been very accurately determined. Unfortunately, the temperature of the flame was low, and the light was rather red; but, on the whole, it was a simple little robust lamp, capable of doing very good work. In this country, there was the Vernon Harcourt pentane lamp, which had gone through various evolutions. The pentane, in the 10-candle power form, was now the adopted standard of light for this country. Its constants had been accurately determined; and it formed an excellent standard, principally on account of the whiteness of the flame. Another important quality was illumination, which depended upon the quantity of light falling on a given surface, and was independent of both the quality of the light and the nature of the surface. In France, the carcel-metre was the unit; and in this country it was measured in foot-candles.

Underlying photometric measurements, said the lecturer, there were two fundamental laws—the first was the law of inverse squares, and the second the law of the cosine. One or both of these laws entered into most photometrical measurements. He then proceeded to deal with the process of measuring the intensity of a light, and next described shortly the different forms of apparatus designed for the purpose—from the Ritchie wedge onwards. When referring to the need for proper ventilation of the photometer-room, he mentioned also the influence upon the work that the condition of health of the operator might have, but added that, of all the difficulties that had to be overcome, the greatest bugbear was the difference in colour between the two lights. There had been much argument on the latter point; but a great deal depended upon the way in which the problem was looked at. When the lights were not of very great difference in colour, and when one became used to photometric measurements, it was not difficult to settle the balance. When, however, it came to lights which had a limited range of wave lengths, the problem became complicated. Various devices had been introduced to overcome this colour difference; and one of these was by the utilization of the principle of "flicker." Much work had been done in connection with these flicker instruments (one well-known form of which was the Simmance-Abady); and they certainly would balance where other photometers gave trouble. But the reliability of such balance is much in dispute. Another proposal was to use the detail-discerning properties of the eye. He explained this principle, and dealt briefly with rotating sectors.

Mr. Jolley said a further thing which remained was to determine the distribution of light that came from a source. It was not accurate to say that a lamp gave a certain light in a particular direction, and that this represented the light of the lamp. They needed to measure either the mean horizontal power or the mean spherical power. Probably the latter was right, in order to get the most scientific result. One of the simplest suggestions was to rotate the lamp; while other plans involved the use of mirrors arranged in certain positions. The question of the polar curve tor arcs was dealt with; and the lecturer then referred to the different patterns of illumination photometers. Not only did they need to measure the candle power of a particular source of light, he said, but very often it was useful to know how much illumination was falling on a given surface.

The concluding portion of the lecture was devoted to spectro-photometry and the spectro-photometer, the radiometer and the radio micrometer, the bolometer, and the linear pile.

Some Aspects of the Chemical Trade.—At the meeting of the Newcastle Section of the Society of Chemical Industry on Nov. 15, 1911, Mr. E. F. Hooper submitted a contribution on this subject. He pointed out at the outset of his paper, that it was only since the passing of the Census of Production Act, 1906, that it had been possible to obtain, even approximately, figures as to the production of chemicals in the United Kingdom. The statistics compiled by Mr. Hooper are of sufficient interest to justify a wider circulation than they would have obtained in the Society's "Journal," in the current issue of which they appear, and therefore the paper has been reprinted, and the author has favoured us with a copy.

THE "STRAND" MANTLE AND ITS PRODUCTION.

A New Method of Mantle Making.

THE manufacture of incandescent mantles has so long been on conventional lines, and the form and general characteristics have so long been, with but slight variations, common to the whole genus, that we had gradually arrived at the conclusion that there was not much chance of any substantial change being made. But when one comes to think of it, it is hardly likely that so many expert mantle makers, who have the whole technic of the subject at their fingers' ends, would continue at work on the production of mantles without, through investigation or by chance, realizing some improvement or something that is totally new. We need an occasional reminder—however good existing things may be, and however well they may have served us—that, in the affairs of this world, we can never put a finger on any one spot, and say "this is finality in this particular line." Our attention has just been called to a new mantle—new not in regard to the materials used, but new in its form, and in the method of its production. The Strand Mantle and Machine Company, Limited, of No. 121, Bollo Bridge Road, Acton, W., are the makers of the mantle. They have only just commenced manufacturing, under the ingenious mechanical inventions (which have been patented) of Mr. J. Ignot Robin, who is confident of the mantle succeeding on all points, both in connection with economical production, and service in the hands of the gas consumer. He will not at present expect us to say more than that the short acquaintance we have had with the mantle gives promise that his views will be confirmed.

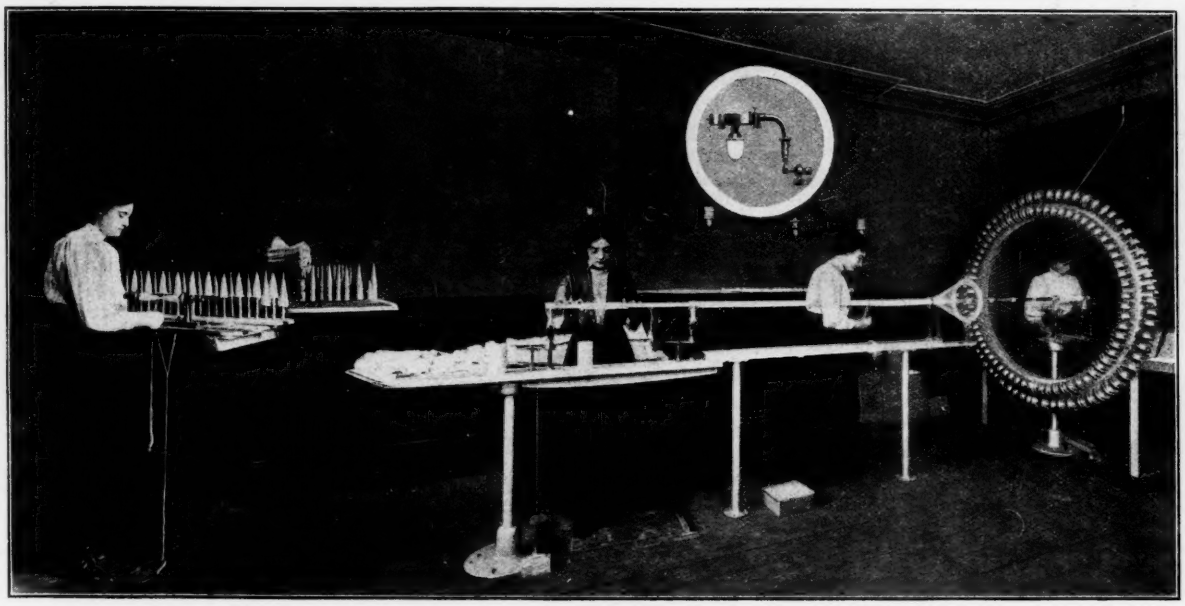
THE NEW MANTLE.

The new mantle, which is of the inverted type, will be known as the "Strand" mantle—deriving its name from the fact that it is formed of a number of loose corrugated strands or threads, which are flexible and uncollodionized, and shape themselves to the flame of the burner on which they are used. The mantle looks peculiar after the stiff inflexible form of existing mantles. There is no limit to the number of threads that the mantle may contain; but the number decided upon has been a subsidiary matter of experiment, and, of course, has relation to the size of the mantle—whether it is required for ordinary, medium, or bijou burners of standard size. In the manufacture, what is known as the best quality Sea Island cotton is employed; the impregnating solution contains 99 per cent. of thorium and the full 1 per cent. of cerium; and the whole mantle is completed ready for use in five processes as compared with four or five times that number in the customary mode of manufacture. This saving of labour is one point in the economy of production; and in the processes that are required nothing much is left to the individual. It is a mantle which, in its production, comes in for more mechanical precision than any other—thus further economy. Less fabric is required for it than for the ordinary knitted mantle. This has been weighed, and found to be quite true. There, again, we have economy; but the fabric is subjected to a heavy impregnation, which is made possible by the all-round production savings that are effected in other respects. There is, too, the saving in collodionizing; and the care and drying that the operation entails under the ordinary system of manufacture. These points are all alluded to, in order to indicate the differences.

Of course, the flexibility of the mantle is a great consideration in connection with transportation, and placing in position on the burner; and there much economy from a consumer's standpoint comes in. Beyond the flexibility, it is a robust mantle. Care has been taken to supply a strong collar, deeply grooved for tying the upper ends of the filaments with asbestos cords; while the bottom ends of the threads are tied in a manner that leaves a small aperture at the base of the mantle, which is stiffened by a little pasty material. Around this small aperture the flame licks, making the mantle as incandescent at the bottom as it is in any other part. The only thing that is different from the use of the ordinary mantle is that the consumer on placing the "Strand" mantle on the burner has to burn-out the fabric by the gas-flame; and then, after regulating the gas and air, the mantle will adjust itself to the shape of the flame of the particular burner on which it is to do service, instead of presenting a stiff form to the flame, and inviting it to do the best with it that it can do under the circumstances. The supporting collars are made for all standard nozzles; and for out-sizes of burners, a special adaptor can be obtained to carry the mantles.

THE MACHINES AND THE PRODUCTION.

We have said that the "Strand" mantle is a mechanically made one; and it will have been appreciated therefrom that there is very little—in fact, we might say, no—room for differences between one mantle and another. In appearance, length, and perfectness of structure, there is uniformity, though production is rapidly accomplished. There are several ways of producing the mantles under the patents of Mr. Robin; but we will only describe the manufacture as it is at present conducted at the factory in which operations have been commenced. It has been explained that the filaments of which the mantles are composed are all of them unconnected, except at the ends round the supporting collar, and where they are assembled at the base. Yet the first operation is to loosely knit the cotton by an ordinary knitting-machine into stocking form. There are three things which this



The "Strand" Mantle-Making Machine (Mr. J. I. Robin's Patent).

knitting accomplishes. It supplies, in a simple way, the corrugations to the filaments as they appear in the completed mantle; it gives to the cotton the necessary elasticity; and it produces the material in suitable and handy form for the impregnating machine. Therefore the knitting process is not labour lost. The knitting machine and the impregnating machine are both driven by electric motors. To the impregnating machine, the knitted fabric is carried. It is placed in the bath of impregnating fluid, and run through the rollers which are under light pressure, so as to retain in the material a good but uniform quantity of the nitrates.

It is in the next department that we come across Mr. Robin's ingenious mechanical inventions, which are called upon to play many parts in the production of the mantles. The largest and most important machine is seen in the photograph. It is somewhat difficult to explain in few words; and yet it is so simple in its action and effects. In the first place, there is mounted on a stand a large cylindrical band, around which are closely arranged glass cylinders. In each of these glass cylinders, a length of the knitted impregnated material is placed; and the unravelling of the material in the subsequent process supplies the corrugated thread for the mantles. The large cylinder supporting band is elevated to a convenient working height by a stand from the floor. Through the centre of this (as seen in the photograph) runs a sliding rod or spindle, also supported by stands, On this rod there are, removably mounted, any desired number of rings or supporting collars to which the mantles are to be secured —the rings being mounted on the rod in pairs in such a manner that the parts of each pair to which the mantles are to be attached are adjacent to one another. Full provision is made in the way of distance-pieces and other accessories, with which we will not over-burden this article. Tension and guide-rings are of the equipment, so as to get all the threads true and of equal length. When the threads have been assembled at the beginning of the work, the operation of the rod carries forward the mantle holders and metal spindles on each of which are formed a pair of mantles, and along the whole length the filaments of the mantles are tightly drawn. All the operator has to do is, with asbestos thread, to tie the filaments round the collar of each mantle, and then separate each pair from its neighbours. The one machine, as illustrated, is capable of producing 3500 mantles per day, and by lengthening the rod, the output could be considerably increased. Again (without going into details as to how the simple operation is done) the attendant transfers the mantles in pairs to a small tying machine, which to the mechanical engineer also appeals for its ingenious points. On this the bottoms of the mantles are cut and tied, and the edge of the apertured bottom just stiffened. The whole operation of manufacture is completed at that; and there only remains the boxing to be done. It will be seen from this how small a part is left exposed to individual discretion or carelessness. The production is mechanically guarded throughout. The machines and the mantles have been fully protected by patents in this country and abroad; and there has not been any question raised by any of the patent authorities as to anticipation in respect of the machines or process in producing these flexible filament inverted mantles.

Mantle Theories and Claims.

Among the claims put forward for the mantle, are the following: (1) Saves one-third gas, and gives a powerful white light. (2) Does not split or crack, nor soil or break glassware. (3) Burns silently on any standard inverted burner. (4) Does not carbonize or corrode burners. (5) Does not require care in handling, in transport, or by users. (6) Perfect combustion of flame. (7) Is not affected by atmospheric changes. (8) Has long life. (9) Fits all standard universal inverted burners. (10) No shrinkage, or changing its original shape after once burned. To enable one to subscribe to all these claims requires much longer experience than we have yet had; but every one of them has been discussed with Mr. Robin, who certainly makes out a very good case. One of the most important points is that of longevity; and he puts this down not only to the flexibility of the filaments of the mantles, being each separate, but to the fact that they are uncollodionized. His theory is that, before the dipping, the mantle is burnt off, then dipped into the collodion, and afterwards put wet into a drying-oven. When the liquid is dried in this way, contraction takes place. Then before or when the mantle is put on to the burner, a light is applied to burn off the stiffening deposit, and thus expansion takes place. This contraction and expansion, he contends, weakens the structure of the mantle. Of course, he admits that the degree of harm done has relation solely to the class of the mantle. There would not be the same effect upon a mantle into which a good quantity of chemical had been put, so as to make a strong body. But the tendency he declares, is for competition to reduce the quality of the ordinary mantles. Then there is the claim of a saving in the consumption of gas. This is produced in various ways. Most burners, and the situation in which they are used, may contribute to this, varying in some degree in the shape of their flames. By shaping the mantle to the flame, a greater and more uniform incandescence is obtained; and this, with the quality of the mantle, it is held, justifies the claim to a saving in gas on the basis of equality of illumination. Then, regarding the claim as to silence in burning, the justification advanced for this is that such a high proportion of primary air to gas is not required for the mixture to secure high illuminating power, and that the balance is freely supplied through the open character of the flexible-strand-made mantle. To the same cause is attributed a lessened deposit on the metal work of the burners above the mantle. Life tests have been made under laboratory conditions; and some extraordinarily high figures have been realized, with less than 10 per cent. depreciation in illuminating power.

Other details were supplied during an inspection of the new process of mantle making; but the general account of manufacture and claims given here is sufficiently descriptive to arouse in the gas industry interest in the new mantle. We shall hope to soon hear of the independent experiences of gas men with the mantle; and upon these experiences much will depend in the matter of the extent of the success that will be derived by it.

At a recent meeting of the Liverpool Section of the Society of Chemical Industry, an exhibition of gas calorimeters was held, and a short demonstration of their uses was given by Mr. R. E. Slade. Three kinds of calorimeters were shown—one being of the old, another of the new Junkers type, and the third of the Boys type. Mr. Slade remarked that the introduction of incandescent gas lighting had made it important that gas should be of a high calorific value.

We have received from Messrs. John Allan and Co. their "Analyses of Municipal Gas Accounts" for 1910-11. The accounts of 80 municipal gas authorities are analyzed, compared with 73 in the preceding issue; all items being worked out at per 1000 feet of gas sold. The makes range from 28 millions to upwards of 8042 millions per annum. To allow of easy comparison of one account with another, cardboard rules, either in blank to allow of figures being filled in, or with the figures of any particular undertaking in the series printed thereon, are supplied with the "Analyses."

DIRECT AMMONIA RECOVERY.

A Contest before the Comptroller-General of Patents—Mr. Radcliffe's Patent Granted as Amended.

It could hardly have been expected that, with several workers in the field attempting to evolve practical processes for the direct recovery of ammonia from hot distillation gases, they would escape having, at some point or other, to join issue, and have their respective claims investigated by the patent authorities. This has happened in the case of Mr. John Radcliffe, of Palace Chambers, Westminster, S.W., the specification of whose patent is headed "Improvements in the Process of, and Apparatus for, the Recovery of Tar, Tar Vapour, and Ammonia from Distillation Gases." Very briefly, in these introductory lines, let us say that Mr. Radcliffe succeeded, in face of the opposition of Herr Walther Feld, in sustaining his claim to a distinctive feature in the process he has evolved, which feature, it is obvious, must make for both economy and efficiency. In looking into this matter, there are several points of interest which induce us to go farther into it than a mere announcement of his success.

The Principles Involved.

It has long been recognized by shrewd observers that, if a practicable process could be evolved for the direct recovery of ammonia from the hot gases resulting from the carbonization of coal—a process that could be used without inflicting undue injury upon the quality of the gas—there would be a gradual supersession and passing of the old and more circuitous forms of attaining the same end. Between the present and separate process of producing sulphate of ammonia and a direct-recovery process, the main question is one of economy; but a secondary, although not an unimportant, one is the difficulty—and it is an increasing difficulty—of disposing of the large quantities of waste liquor remaining after the distillation of the ammoniacal liquor for ammonia recovery, which waste liquor contains poisonous cyanides that have in places brought sulphate of ammonia makers into somewhat uncomfortable collision with local governing authorities. It is elementary and fairly well-known information that the course of working in direct ammonia recovery has been, in order to avoid, or to largely reduce, the volume of, effluent, to pass the hot gases resulting from coal carbonization through a saturator in contact with sulphuric acid, for the recovery of the ammonia as sulphate, while the water vapour passes away with the exit gases. In coke-oven practice, the gases, *plus* water vapour, pass to the heating flues, and are there burnt; the water vapour passing away with the combustion products. In gas-works practice, after the recovery of the ammonia, the gases would be cooled and the water originally produced from the coal recovered. No scrubbing-water, however, would be used. It is an essential that the tar particles and tar vapours should be previously removed, so as to avert the contamination and discoloration of the sulphate of ammonia.

From this it will be observed that two quite distinct processes are involved in the direct recovery of ammonia; and this brings us to the point where the process evolved by Mr. Radcliffe is distinct from the systems of previous workers. The saturator in which the hot gases come in contact with sulphuric acid, whereby sulphate of ammonia is formed, will not work at a lower temperature than 250° C (482° Fahr.); and yet the tar must be extracted before entering the saturator. It is manifest, therefore, that if the gas be cooled to (say) 25° C. or 75° Fahr. in the ordinary tar-extraction process, additional heat must be supplied either to the gas or to the saturator; and, moreover, the cooling would result in the condensation of the water vapour along with the tar, which would nullify the advantage of the process. What Mr. Radcliffe does is to so maintain the temperature of his gas up to the point at which the tar particles and tar vapour are removed, that no additional temperature is required, either for the heating of the ammonia saturator or the gases, to enable the work of ammonia recovery to proceed, and to allow the water vapour in the gas to pass forward without condensation. The point was well put by Mr. Eric Bousfield, in placing Mr. Radcliffe's claims before the Comptroller-General. He remarked that what his client was doing was "carrying on the process of extracting the tar in such a way that the gases as they left the tar-scrubbers needed no superheating before they entered the ammonia saturator. Instead of having, as was the case with the prior processes, to add extraneous heat to the gases for the purpose of raising their temperature, or extraneous gases for the purpose of lowering the dew point for water, he extracted the tar at such a temperature that the gases never got cool, but left the tar-scrubbers at a temperature sufficiently high for the saturator to be worked with such gases without the addition thereto of any extraneous heat or extraneous gases. What really happened was that the extraction of the tar was not carried to completion, since the last trace of tar could only be extracted at a temperature so low that further treatment of gases would be essential before they could be passed into the ammonia saturator. Therefore some of the last traces of tar were allowed to remain in the gas; this loss being more than compensated for by the fact that superheating appliances are rendered unnecessary." In accomplishing what is here described, it seems plain that Mr. Radcliffe has succeeded in producing economy, simplicity, and efficiency. In this, it appears unquestionable that he has effected an improvement upon preceding work.

Prior Invention.

The work that has proceeded in connection with the direct recovery of ammonia is fairly extensive. The patent specifications take us back to 1889. In that year the Coltness Iron Company, Limited, and another were granted a patent (No. 17,673). Eleven years later (1900) came the patents of Naef and Chandler and another, respectively Nos. 6924 and 18,211. Two years elapsed, and then (1902) came Feldmann's patent, No. 11,525. Another two years went by, and then (1904) Koppers' specification of his patent was published (No. 20,870). Feld is the most modern of workers, apart from Mr. Radcliffe; and in 1905 his patent specification (No. 26,262) was published, and a further one from him saw the light of day in 1907 (No. 20,139). It was Herr Feld who opposed the granting of a patent to Mr. Radcliffe. In all these cases, the inventors appear to have devised means for extracting the tar from the gas without at the same time extracting the water vapour; and the inventions have a strong family likeness, with the exception of that of Koppers. He does not purpose the use of oil-scrubbers, but the extraction of tar in ordinary cooling and condensing apparatus. And further in his case the condensation of moisture in the saturator is prevented by employing the acid bath of the saturator at the necessary temperature—heat being added to the gas. Generally speaking, the workers have proposed the scrubbing of the gases in one, two, or more scrubbers with tar or oil, so as to recover the tar and the tar vapour from the hot gases—taking various means to provide that the water vapour in the gases is not condensed. Therefore no fresh patentee could claim novelty in that respect. Nor is there novelty *per se* in passing gases through an ammonia saturator under such conditions as to prevent condensation of water in the vessel.

The Comptroller-General's Decision.

Nevertheless, the Comptroller-General in his investigation, as the result of Herr Feld's opposition to the granting of a patent to Mr. Radcliffe, was persuaded that the latter had gone one stage better in regard to the matter of temperature; for his decision clearly drew the line at what had been previously done, and pointed to the extent to which Mr. Radcliffe, in his patent (No. 28,868, 1909), had stepped beyond that prior work. He insisted that the specification should be amended, in order that acknowledgment should be made of the stage to which the work of direct ammonia recovery had been carried by previous patentees; but —this is the main point—he said he did not think he should be justified in refusing to grant Mr. Radcliffe a patent, as, in his opinion, the specifications brought to his notice did not anticipate in terms the maintaining of the temperature at the exit of the tar-scrubbers to such a degree that the gases might be passed without further treatment through the saturator, and so that water vapour was not condensed. "The patentees of the prior processes," he added, "appear to have realized that it is very difficult to keep the temperature up to the desired point; and they suggest extraneous means for this purpose." It was also suggested in the decision that Mr. Radcliffe's specification should be amended (as it has been) to make it clear that his invention consists in maintaining the temperature of the gases so that the gas passing through the tar-scrubbers and the saturator does not at any stage receive any addition of heat or hot gas.

Some Details of the Radcliffe Process.

From the foregoing the general characteristics of Mr. Radcliffe's patent have been made clear; but it will be of interest to describe them a little more particularly. For the removal of the tar, the gas is passed in an ascending current through scrubbers in contact with a diffused descending stream or shower of added oil or tar; the gases being maintained throughout the process, as previously stated, at a temperature sufficiently high to prevent the condensation of water vapour, and this without supplying heat to the gases at any stage, or the addition of gases. For commercial reasons, it is more convenient to use a tar product, or tar itself; and this arrests the tar particles and vapour. The lines of working as described in the amended patent specification are as follows:

> It is obvious that the temperature of the boiling of the oil should be suited to the temperature to which it is exposed, so that it shall do the required work in the liquid state. At the same time, an evaporation of a part of it and subsequent condensation will promote the extraction of the tar. Therefore, one scrubber may be working at a high temperature, which may vaporize part of the oil; while a second scrubber, to which the gas passes from the first, may work at a lower temperature. The fall in temperature may occur naturally through heat being given off into the atmosphere, or may be artificially produced by the interposition between the two scrubbers of a condenser-scrubber or other cooling vessel. It results in condensation from the gas of oil and tar vapour, and the condensate in this second scrubber may circulate to the first scrubber. More than two scrubbers may be used if desired.
>
> While it is desirable for economical reasons to condense in the second scrubber all oil vapours thus added to the gas in the first scrubber, and abstracted therefrom as above described, it should be noted that the presence of such in the gas passing to the saturator may cause tar vapour to be held which, however, it will fix for practical purposes—that is, prevent condensation thereof in the saturator; and upon combustion the heat value will be recovered. However, oils and mixtures of such definite boiling-points may be employed that a workable variation of temperature will result in effective vaporization and condensation.
>
> With regard to the scrubbers, any known form of apparatus may be

employed for bringing a diffused stream or shower of liquid into contact with a current of gas, modified if necessary for working at a high temperature. But the patentee recommends a form of the known type having an internal rotary shaft with cooled bearings; this shaft carrying metallic bristles effectively filling the space enclosed—the apparatus being vertical in construction, with the gas entering at the bottom and leaving at the top, means being provided for rotating the shaft, and for lifting the oil continuously from the bottom and delivering it to the top.

Provision having thus been made for the deposition of tar and tar-vapour and for the retention of the water in the gas as vapour, the gas is passed into a saturator, desirably providing for increased contact because of the increased dilution of the ammonia, and increasing the temperature if required—for instance, when starting the process; it being understood that the saturator must never be heated above the temperature of the entering gas. Preferably, a double or multiple arrangement of saturator of known form is employed; the strength of acid used being such that sulphate of ammonia is precipitated from a supersaturated solution in the lowest or first of the series to which the ammoniacal gas is admitted, without necessarily recovering all the ammonia from the gas. The gas then passes to an upper one or series to which acid is supplied continuously, in quantity depending upon the input of ammonia, overflowing to the bottom of the series or pair. The sulphate of ammonia may be removed by well-known means, and the water-vapour passes away along with the combustible gas for further treatment or burning.

The claim, as finally settled, is as follows: "The herein described process of recovery of tar, tar-vapour, and ammonia from hot distillation gases, wherein the gases are passed, firstly, through one, two, or more scrubbers in contact with a diffused stream or shower of added oil and (or) tar at such a temperature that the water vapour contained in the gases is not condensed, for tar recovery; and, secondly, to a saturator for recovery of ammonia without condensation of water vapour, the temperature of the gases being maintained throughout such process, so that it is unnecessary to supply heat to the gases at any stage, or to add gases thereto, for the purpose of preventing condensation of water vapour."

It is easy to see from this that the process as improved by Mr. Radcliffe carries the direct recovery of ammonia farther than the former workers went, through the maintenance of the temperature of the gas without external assistance, with the water travelling away still in the form of vapour with the gas on its exit from the ammonia saturator. Naturally, he is to be congratulated on having satisfied the Comptroller-General that his process contains distinctive and patentable features, providing for something materially beneficial that his predecessors in this field of investigation and invention did not reach, and thus enhancing the practicability and value of the process of direct ammonia recovery. We hope that the system will soon receive practical trial, so that working results may be produced for the inspection of the technical officials of gas undertakings.

THE "HOLOPHANE LUMETER."

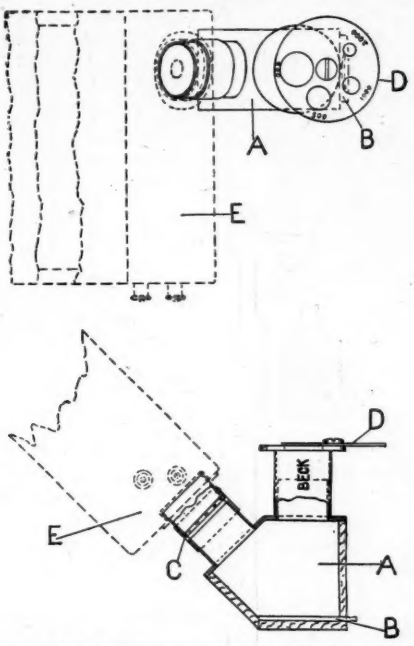
A NEW TYPE OF PHOTOMETER.

In connection with the annual exhibitions of the Physical Society at South Kensington, as well as upon other occasions, reference has been made in the "Journal" to the "Holophane Lumeter." As may be remembered, it is a portable little instrument which takes at a glance the brightness of any surface in candle-feet. It consists of a small box, on looking into which an illuminated disc with an aperture in the centre is seen. On pointing the lumeter at the surface or object to be examined, this will be seen through the aperture; and it will appear more or less brilliant than the surrounding white disc. By merely moving a handle, the brilliancy of the illuminating disc can be reduced until it is the same as the object under examination; and the brightness of the object is immediately read on a scale of candle-feet. If the object is white, the aperture in the disc will be invisible when the correct value has been obtained. If it is coloured, one or two trials will enable an equal intensity between the white disc and the coloured aperture to be obtained. The range of the instrument is from 1-100th of a candle-foot to 2000 candle-feet.

The usual type of photometer determines the brightness of a lamp or other source of illumination; but it cannot be used to ascertain the brightness of an object or surface. The measurement of such sources of light is useful, and can be made with the lumeter by means of a special attachment; but the measurement of the illumination of a surface or object is what is of real value. It is claimed on behalf of the instrument under notice that it enables the whole question of light and illumination to be studied scientifically.

It was mentioned in the "Journal" for the 9th inst. (p. 88) that a new model of the lumeter, embodying improvements upon the original instrument, had been introduced. It possesses several important advantages over the early models. The principle of construction is the same; but the use of a lamp which consumes only half the current gives the accumulator a much steadier run, and enables it to be used for more than double the time without any variation in the standard brightness of the lamp. The new model is of a handier and more convenient shape than its predecessor; and having only one continuous scale, instead of two separate ones, it is less liable to be misread.

A new feature of the lumeter is a daylight attachment, which enables direct comparisons to be made with the light of the sky. It is intended for comparing the illumination at any spot in a building with unrestricted illumination outside, thus obtaining a measure of the efficiency of the arrangements for the admission of daylight. It is shown in the accompanying diagram.



Daylight Attachment for the "Holophane Lumeter."

In general, the unrestricted outdoor illumination is too high to be conveniently measured with a photometer direct. Moreover, it is often difficult to find a spot where the daylight is not to some extent obstructed by neighbouring buildings. The method, therefore, consists in utilizing only a small fraction (*e.g.*, 1-100th or 1-500th) of the total sky area. For this purpose a piece of celluloid surface B, identical with that used for indoor measurements in the ordinary way, is covered with a tube (blackened internally) a few inches long. At the end of the tube there is a small aperture D, of such area as to allow light from only a specified portion of the sky to reach the surface. Four apertures, marked respectively 1-2000, 1-1000, 1-500, and 1-200, are provided. The apparatus is fitted on the end of the lumeter E, and the observer points the tube towards the zenith, and observes the brightness of the standard celluloid screen illuminated through the aperture at its extremity. The reading of the instrument must then be multiplied by 2000, 1000, 500, or 200, as the case may be. The daylight attachment is then removed, and a horizontal measurement is made inside the room in the usual way. The ratio of these two readings is regarded as independent of climatic conditions, provided a cloudy sky of approximately even brightness is secured; and it represents the efficiency of daylight admission for the place in the room examined. The attachment is provided with a detachable daylight colour screen, to obviate the colour difficulty. It is, of course, retained for both measurements.

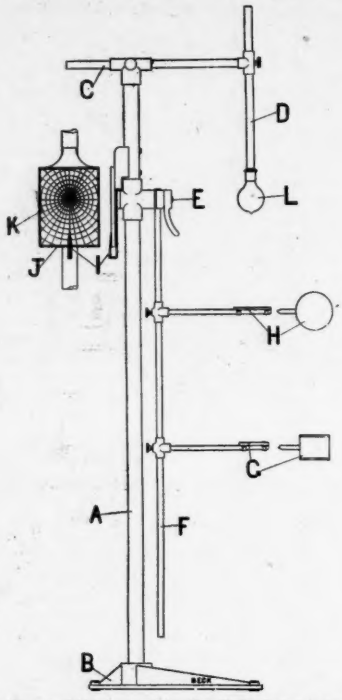
Another new feature in connection with the lumeter is the polar curve apparatus—an appliance for plotting-out the intensity of light from a source in all directions. Polar curves, when taken in large numbers for different classes of illuminants and reflectors, involve enormous labour if the ordinary photometer bench and large costly mirrors are used. The apparatus under notice, which is shown in the accompanying diagram, is a simple instrument for effecting the same result. The method consists in keeping the source of light still, and rotating round it a white screen, the brightness of which is ascertained with the lumeter at each angle, and noted on specially ruled paper.

The new apparatus (p. 278) consists of an upright A, fixed on a firm base B. At top of the upright is carried a cross-bar C, which holds a tube D, to which the lamp L, or reflector or illuminant to be tested, is affixed. The lamp may be raised or lowered horizontally or moved laterally until it is in the centre of an axis E. Upon this axis a rod F swings, and can be clamped at any angle. The rod carries a screen G, which is matt-white, and also an obscuring screen H to shield the direct rays of the illuminant from the screen G when desired. As the rod F is rotated, its position is recorded by an indicator I on a board K, upon which a ruled-paper polar curve chart J, with circles and angles, has been pinned.

The method of using the instrument is as follows: Place a lamp of known candle power in it, and the screen H having been turned to one side, move the matt surface screen G towards, or back from, the lamp until the reading of the lumeter assumes some convenient value—say, 1 candle-foot. The matt-surface screen is then fixed at this distance, and the apparatus is ready for use. If the lamp used as a standard has been, for instance, 10-candle power, then 1 candle-foot on the screen will represent 10-candle power; and all the results obtained by the lumeter in

examining the screen must be multiplied by 10, so as to give the required results in candle power.

The apparatus has now been set, and the illuminant or reflector to be tested is placed on the rod D and adjusted until it is in the axis E around which the matt-surface G rotates. A piece of polar curve paper J is attached to the diagram-board K, and the rod F is rotated successively till the indicator I is at the various radial lines on the paper; the illumination on the matt-surface screen being read with the lumeter at each successive position. The value obtained is marked on the paper; and thus a curve of intensity is rapidly plotted out without any of the elaborate methods previously employed. No laborious calculations are required. The curve steadily grows on the paper as the test is in



Polar Curve Attachment to the Holophane Lumeter.

progress; a few minutes being generally sufficient for the whole operation. If this is carried out in a room with evenly distributed stray light, the opaque screen H can be placed between the illuminant and the matt-surface screen G and the amount of illumination from outside sources measured, which must be deducted from the readings obtained during the test. If the illumination in the room is small compared with the power of the lamp being tested, this source of error can generally be neglected.

The advantages claimed for the apparatus include the following: It is very quickly used; the polar curve is worked out while the test is in progress, without calculation; the apparatus, being portable, can be moved from room to room; stray light from an ordinary room can be allowed for; and one observer only is required.

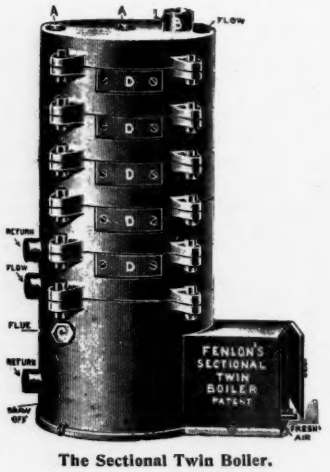
Mr. William Henry Cobb, of South Woods Hall, Thirsk, Vice-Chairman of the York Water Company, who died on the 19th ult., aged 78, left estate of the gross value of £50,277, of which the net personalty has been sworn at £45,280.

The King has awarded the Edward Medal of the First Class to Mr. George Henry Rhodes, and the Edward Medal of the Second Class to Messrs. Sidney Dickson and Herbert Wood, in recognition of their rescue, in the presence of great danger, of a man, who, through an explosion of gas, was imprisoned in an underground washer-tank at the Effingham Street works of the Sheffield Gas Company.

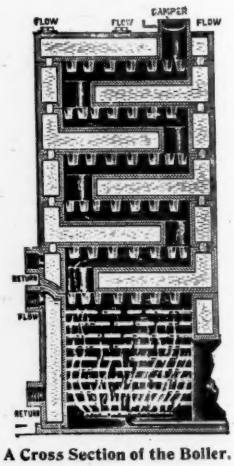
We have received from the Engineering Standards Committee, on which Mr. James W. Helps represents the Institution of Gas Engineers, their report (No. 57 of the series) on British standard heads for screws of sizes ranging from 0·236 inch to 0·039 inch diameter. The Committee standardized five classes of head—viz., countersunk, instrument, round, cheese, and filister; and they recommend the adoption of a standard angle of 90° for both countersunk and instrument heads. In the case of the other three classes of screws, they recommend that the dimensions of the heads should be defined by a table contained in the report, and that, unless otherwise specified, a plain cylindrical portion, having a length not exceeding twice the pitch, should be left on the shank immediately underneath the heads of the screws. For saw-cuts, the Committee recommend a standard depth equal to half the total depth of the head in all cases—such depth being measured at the centre of the head. Accompanying the report is a plate of diagrams of the standard heads. The report is published for the Committee by Messrs. Crosby Lockwood and Son, of Stationers' Hall Court, E.C., price 2s. 6d.

FENLON'S SECTIONAL TWIN GAS-BOILER.

ONLY the fringe of the business in heating water by gas has so far been touched; and it follows that the bulk of the trade has yet to be obtained. The entry into the possession of this large business is daily being made more possible by the work of inventors, and by the cheapening of the gaseous fuel. Mr. H. T. Fenlon, of No. 8, Tudor Street, Blackfriars, E.C., has long been engaged in this particular work; and his types of gas water-heaters are varied, and made for all purposes—from safety geysers for heating water for baths to large boilers for the economical heating of large establishments, or for meeting the hot-water requirements of such places, or for heating conservatories or garages. His latest development is a "Twin" sectional boiler, which can be built up, much after the manner of sectional book-cases as desired to meet the growing requirements of any premises. It is an advance upon what is known as Fenlon's "Twin" cast-iron boiler, which derives its name from the fact that in it one has two systems of heating from a single heat source. In other words, there are in the one structure, and heated from the one gas-burner, two boilers—a lower and an upper one; the lower one being for domestic supply, and the upper one for the heating installation of a house. The heat-energy of the gas-flame first does its work on the bottom, or high-pressure boiler, and then the heat passes to the upper, or low-pressure, boiler for raising the temperature of the water for the heating installation. The economy of the arrangement will be at once recognized; for the thermal value of the gaseous fuel is utilized to the largest possible extent. Of course, in the summer time, the heating part of this equipment will not be required; and it is so arranged that by the simplest means, it can be thrown out of use. Both the flues—the upper and lower ones—are fitted with dampers. In the winter time, when both boilers are in commission, the bottom damper is closed, and the top damper is opened—the heat thereby passing through both systems. The reverse is the order of things in the summer time, when the heating installation is not needed, but only a domestic water supply. Then the bottom damper is open, and the top damper closed; and the consumption of gas can be reduced for the domestic supply. Mr. Fenlon is proud of the capabilities and efficiency of this "Twin" boiler; and in conversation he incidentally mentioned that two or three months ago, a gas company ordered the installation of one of them, with a 45-gallon storage tank 50 feet away from the boiler, and fitted with 60 feet of 4-inch heating pipe. The report as to its working is that it is running very satisfactorily. This patent boiler is put forward as being both economical in fuel and space; and as separate boilers are not required for each purpose, there is a saving in installation expenses.



The Sectional Twin Boiler.



A Cross Section of the Boiler.

Now upon this comes the sectional "Twin" boiler. The principles are the same—the only differences being structural. In this case, the top boiler is built up of standard size sections, studded and bolted together. This enables it to be built up to any suitable size, and then, if additional power is required at any time, the size can be increased by inserting a fresh section or sections. It will be seen from the illustration that the top boiler in this type is built in the form of a vertical column; and the external appearance of the sections is clearly depicted, as is also, in the sectional illustration, the interior arrangement of the boiler. The design is such that the utmost use is made of the heating power of the gas. The burner is a very efficient one; and the flames from it are made to play on the side ribs of the bottom boiler. The more sections of which the top boiler is composed, the lower is the flue temperature; the products of combustion being caused to travel in a circuitous manner before reaching the chimney or uptake. In any case, the extremely low flue heat, points to the good heat efficiency of the structure. In the installation of the boiler, Mr. Fenlon prefers to connect up the flow-and-return heating pipes to the top segment and bottom of the boiler; but the pipes may, of course, be connected to suit

the position in which they are to be placed in relation to the situation of the boiler.

The six-sectioned boiler represented in the illustration is equal to 46 gallons of water—that is to say, two 20-gallon tanks, and 6 gallons in the boiler. The maximum consumption of gas, with this size of boiler (this we personally tested), is 40 cubic feet an hour—for both domestic hot water and the general heating of the establishment. The boilers are strongly constructed—being made to withstand 100 feet head of water.

With regard to the heat efficiency of the size of boiler here described, the following are the results of temperature tests that have been made; and the figures are confirmed by our own readings of the thermometers:

Results of Temperature Tests with the Sectional "Twin" Boiler.

Jan. 6, 1912.	Flow.	Return.	Flue.
½ hour	105°	74°	83°
1 ,,	117°	82°	96°
1½ hours	133°	104°	106°
2 ,,	142°	118°	105°
2½ ,,	156°	131°	103°
3 ,,	165°	144°	104°
3½ ,,	176°	154°	106°
4 ,,	185°	163°	106°

Cold water 45° Fahr.

Jan. 10, 1912.	Flow.	Return.	Flue.
½ hour	89°	—	74°
1 ,,	97°	58°	86°
1½ hours	117°	85°	109°
2 ,,	128°	100°	121°
2½ ,,	142°	113°	129°
3 ,,	156°	125°	123°
3½ ,,	167°	134°	116°
4 ,,	179°	141°	116°
4½ ,,	186°	149°	116°
5 ,,	193°	156°	117°

Cold water 44° Fahr.

Jan. 23, 1912.	Flow.	Return.	Flue.
½ hour	94°	56°	80°
1 ,,	104°	71°	94°
1½ hours	120°	90°	114°
2 ,,	130°	104°	124°
2½ ,,	143°	118°	126°
3 ,,	152°	128°	120°
3½ ,,	162°	139°	116°
4 ,,	172°	145°	112°
4½ ,,	182°	154°	112°

Cold water 45° Fahr.

Gas was turned out, and 40 gallons of water were drawn off into an open tank. At the start it left boiler at 180°, cooling down to 174°. The whole bulk was then well stirred; the thermometer showing 162°.

The low flue temperatures in the foregoing representative tests will be remarked. Nothing more need be said to recommend this boiler. There is no doubt that it will render as good an account of itself as the 16,000 gas water-heating installations that Mr. Fenlon has made since he first engaged in this particular branch of the business.

Repairs to a Steel Chimney, 100 feet high and 6 feet diameter, were recently needed in seven courses in the middle of its height. The top five courses were in good condition, and rather than lower them to the ground and then raise them again, involving the handling of about 2 tons, the contractors for the work supported them on a scaffold while the lower sections were replaced. This scaffold (with four 6-inch square posts, cross-braced with 1 in. by 6 in. plank) was in service about a fortnight.

Naphthalene in Road Tars.—The subject of the effect of naphthalene upon the consistence of refined tars was dealt with a short time ago by Messrs. P. Hubbard and C. N. Draper in the "Journal of Industrial and Engineering Chemistry;" and an abstract of their article appeared in a recent number of the "Journal of the Society of Chemical Industry." It is remarked that tars used as binders are generally prepared by distilling from 15 to 20 per cent. of the lighter products from crude tar, and would be more correctly termed soft pitches. An investigation of the principal chemical constituents of road tars and their effect upon the quality of the products is being conducted in the Office of Public Roads, United States Department of Agriculture; and the paper deals with the effects produced by naphthalene. The naphthalene was removed from samples of coal tar and water-gas tar by distillation, and then the effect of the addition of varying quantities of naphthalene to the resulting hard pitches was studied. It was found that the consistence (measured at 55° C.) was remarkably diminished by small additions of naphthalene; while with further additions the effect was not so marked. With the pitch from coal tar, the most fluid product was obtained with 20 per cent., and with that from water-gas tar with 25 per cent., of naphthalene. Larger additions gave less fluid products, owing to crystallization of the naphthalene. The fluxing power of napthalene for tar pitches is somewhat greater than that of heavier distillates, free from naphthalene, obtained from tar; but the effect would be less permanent, owing to the ready volatilization of naphthalene. The fluxing effect of naphthalene is more marked with harder than with softer pitches.

LONDON AND SOUTHERN JUNIOR ASSOCIATION.

A Meeting of the London and Southern District Junior Gas Association was held last Friday, at the Westminster Technical Institute, Vincent Square, S.W.—under the presidency of Mr. J. G. Clark, of the Gaslight and Coke Company. Two subjects were introduced for discussion by the members.

Mr. H. H. Creasey (Gaslight and Coke Company) submitted the first question, with a short paper entitled

EFFICIENCY AND ITS RELATION TO THE PERMANENT SATISFACTION OF THE CONSUMER.

Of course, we all know that, to satisfy the customer, we must give efficiency in attention, service, courtesy, &c.; but it is more on the subject of efficiency of appliances that I want to induce a discussion, as my experience shows me that on the efficiency and the constant efficiency of every gas appliance in use, large or small, depends the permanent satisfaction of consumers. Note the word "permanent." A consumer may be satisfied to-day with something one fixes for him; but will he be satisfied to-morrow, the next day, and every day after? If not, or if we are not satisfied that the appliance is kept up-to-date and efficient, we must not forget that someone else with an appliance that can be used for exactly the same purpose, is waiting to seize the chance of getting him as a customer, just as we wait our chance to take a consumer who is dissatisfied in any way with the electric light companies or the coal merchants. This question of efficiency, therefore, by no means refers only to gas companies—it refers quite equally to all our competitors. Unless the appliance (let it be gas, electric, or coal) in use by an individual is up-to-date and efficient, there is an opening for a competitor to step in and give a better result.

Let us return to the subject as it affects ourselves as sellers of gas. How many consumers have been lost either partly or wholly without us having the chance to save them, without our even being consulted in the matter, when had we known what was happening we could have proved to them that, with more efficient and up-to-date gas appliances, the advantage would have rested with us and not with the competitor who was superseding us—not, let it be noted, on his merits, but because he was offering an up-to-date appliance, with its consequent greater efficiency and economy, as compared with our out-of-date and inefficient gas appliance that was in use. In my opinion, it behoves us, therefore, with maintenance, maintenance, and again maintenance, to keep all gas appliances up to a constant efficiency, and, what is even more important than all, under our eye. Every man, be he workman or officer, in the service of a gas company should keep his eyes open for out-of-date or inefficient appliances, and should report matters when noticed to the next above him in authority, and he to the next one, until eventually it arrives at the man who deals with these things; and that man should not rest until the danger spot is wiped out. I call it a "danger spot," because it assuredly is one. Every person who sees the appliance sees a bad advertisement for gas; and if it be displaced by that of a competitor, this will, of course, then be an up-to-date one, and a constant advertisement for that competitor.

When one talks like this, I can hear electricians saying, "Oh! frightened of electricity." Absolutely no, on its merits; but if, as so frequently happens, they compare their most modern appliances with our out-of-date ones, and we give them the opportunity to do so, it is quite understandable that we are then at a disadvantage. For instance, an electrician calls at a house which is lighted by old flat flames, badly maintained incandescent burners, or badly chosen size or pattern lighting units. Of course, he can offer the customer favourable terms, and perhaps knocks out the gas—which event he shouts from the housetops as being a great triumph. But what if one of us had stepped in first, and, without waiting for a complaint, or without waiting for someone else to steal our customer, had boldly approached him with a clear statement as to the saving in consumption, improvement in light, &c., that could be obtained with modern or suitable incandescent gas-burners and maintenance, and offered to fix on approval for a time, till the customer was satisfied—making it clear that his saving would soon repay his outlay—and then the modern lights were installed and maintained efficiently? What chance would the electric light have then? Absolutely none.

I can quote you a case which I am at present dealing with, where we nearly lost a very large account, solely owing to the fact that a lot of flat-flame burners were still in use, and the electricians came along and offered a "new heaven upon earth" with figures naturally comparing very favourably with ours. Quite by chance we heard of it, and with some difficulty obtained permission to quote—I am pleased to say successfully. Another case I have in mind is that of a firm of restaurant keepers who have a number of cafés in London. Quite casually we obtained permission to inspect these premises; and I found many things that a competitor could shoot at—bad and extravagant gas-fires, high-power 60 feet an hour drip-proof boiling-rings to boil thick iron kettles, &c. Now the doing away with these will mean an initial loss in the gas consumed; but surely this will be more than repaid by the constant advertisement of the good gas-fires seen day by day by hundreds of customers at the cafés, and also by the extremely friendly feeling engendered between us and the con-

sumers, who will never forget the fact that we showed them how to save money in their gas consumption, while giving them greater efficiency than ever before. We like to see the output of gas increasing by leaps and bounds; but all this will be of no avail unless the consumers' appliances are permanently efficient. It is much better for us to have a satisfied and efficiently supplied consumer at 50,000 cubic feet per quarter than a dissatisfied or badly supplied consumer at 100,000 feet, as sooner or later we should lose the 100,000 feet consumer altogether.

I had another case in which a vulcanizing firm complained that the gas pressure varied in different parts and affected their vulcanizing apparatus, which they sell all over England; and they wished to know whether we had any suggestions to make, as they were considering installing coke-furnaces for their purposes. Some of their appliances consumed 400 cubic feet per hour—well worth having. I found that in practically every case the burners were wrongly designed for the appliances—in other words, were inefficient; and I obtained permission to experiment. The experiments resulted in my showing them a saving of 45 per cent. in time and 40 per cent. in gas consumed, in the various appliances, to carry out exactly the same work. This has caused the firm to entirely reconstruct them, and has placed gas in a pre-eminent position, as they told me that any other source of heat, as far as they are concerned, is now out of the question. But we must remember that the matter does not end there, as, efficient though these new appliances may be, they must be kept efficient and up-to-date, because as improvements are effected in other sources of heat we must keep on improving as well, or, in other words, the industry that does not go forward must go back. There is no stopping-place.

Touching for a moment on the subject of gas-fires. There can be no doubt that there are still many old, badly fixed, out-of-condition, and inefficient gas-fires in use, many fixed with reducing flue elbows and other abominations to condemn them and us; and we must all do everything in our power to bring these up-to-date as far as possible. The Gaslight and Coke Company are remodelling the standard pattern fires of what I may call the previous-to-pillar-fuel type by bringing the back brick forward, and fixing a new burner with gas and air adjuster, one row of pillar fuel, and a single fuel bar or clip. This results in economy of gas consumption, better radiation, and the lower temperature convected heat that is so much to be desired. In fact, it makes a very good fire. I learn from Mr. W. Fagan, Superintendent of the Gaslight and Coke Company's Stoves Department, that when we find an old private fire of this type, if the consumer does not care to hire a modern fire, a remodelled one of the same type, which is to all intents and purposes a new fire, can be delivered, and the old one taken back in exchange, for a total charge of about 7s. This I think should prove of great assistance to us in effecting some necessary improvements at times, when other efforts fail.

Now the several actual instances I quoted a few minutes ago of cases where inefficient appliances were doing us material harm by leaving us open to be attacked, were nothing exceptional. I am sure there are many similar or even worse cases, and that any one of us is capable of suggesting and carrying out the necessary improvements, given the opportunity. Mark that, however—"given the opportunity." But suppose the consumer does not complain, or does not draw attention to these appliances, because he does not know we can do better—that is to say, we are not given the opportunity. That is what I am aiming at to-night. We should not need these opportunities to be given to us, we should make them. Every one of us should be all eyes and ears when in a consumer's house, and should not be afraid of approaching him in the event of our seeing something that is not up-to-date, or, if up-to-date, is not giving its greatest efficiency. If it is unwise (as is frequently the case) to approach him at the time, save it for a little later, and send a judiciously worded letter. I have found no serious difficulty in getting consumers to go to an initial expense so long as one makes the proposal quite clear, and takes some risk oneself (in supplying on approval, for instance), and quotes clearly (not vaguely) some idea of what the saving will be, quite apart from the increased efficiency.

There can be no doubt that, in the special cases I have mentioned, the appliances were "danger spots," not only to the Company I represent, but to the gas industry at large. What is to the interest of one gas company is to the interest of every gas undertaking in the world—for one thing because these appliances were bad advertisements, and for another because consumers are continually moving from place to place, and come into contact with friends and relations, when gas is sometimes talked about. A satisfied consumer is the best of all advertisements. We are proud of our industry, and mean it to remain on top, as it is at present in spite of all competitors. But "When at peace with a consumer prepare for war," should be our motto; and we should be always arming ourselves against outside attacks by keeping our weapons—that is, gas appliances, and ourselves—constantly and permanently efficient. If this be done, I am confident that we shall have nothing to fear from the future.

Discussion.

The paper led to a long and very keen discussion, of which a summary is appended.

Mr. F. Ainsworth (Ilford) remarked that he was greatly interested in the suggestion with reference to making old gas-fires into new. It was a very nice idea, if it could be done as cheaply as the author had stated. In this way, they would be able to keep consumers that they would not otherwise do. He quite agreed with having all their men, and even boys, trained to let those above them know what was going on in the district. Inverted vertical burners had helped them greatly; but he had been largely adapting water-slide pendants for swan-neck burners. They made a nice fitting, and people had been better pleased with them than with new ones which might cost a considerable sum. These swan-neck burners were giving better results than either upright or vertical inverted burners. He would like to see the makers go in more for special fittings suitable for the swan-neck or angle burner. He expressed the opinion that the adjustment arrangements were more conveniently situated than those of the vertical inverted burners.

Mr. J. Hewett (South Metropolitan Company) mentioned the adjustment of burners on gas-cookers. He said it was all very well to test a stove on the gas company's or manufacturer's premises, and see that it gave a beautiful flame; but it was in the consumer's house that this kind of thing should be done—at any rate, in some small measure. As another point in regard to efficiency, he stated that some time ago he had a gas-iron fitted in his house. One day he watched and checked the meter, and found that with this iron in operation, and two lights going, for two hours, the total amount of gas consumed was 15 cubic feet. This, he thought, could be looked upon as an instance of great efficiency.

Mr. S. A. Carpenter (Mill Hill) asked whether the author was in favour of practically universal maintenance. Had he any idea of the proportion of incandescent burners in his district that were at present maintained? Did it reach 50 per cent.? [Mr. Creasey: No.] It seemed a little difficult to get consumers to pay for maintenance, and perhaps the author was in favour of doing this free. Of course, if dirty vessels were placed on a cooker, a smell would result; and there was also the effect of cold iron coming into contact with a hot flame. How often would Mr. Creasey send to overhaul or examine cookers, fires, and circulators on maintenance; and, with regard to the latter, what would he actually have done?

Mr. G. F. Cox (Commercial Company) agreed that they should not wait for opportunities to come along, but should make them. If every fitter and inspector on the district was informed that the company were on the look out for them to report any bad system of lighting, &c., they came across in their rounds, and understood that instant attention would be given to these reports by a personal call, this would go a long way towards securing efficiency. It was waiting until the consumer complained that was the cause of a great deal of inefficiency.

Mr. S. B. Chandler (South Metropolitan Company) alluded to the anthracite stove, and said he was afraid this would ultimately become a serious competitor. He believed most companies had a system whereby a perpetual canvass was carried on, so that they were constantly in touch with the consumers.

Mr. W. E. Brown (Gaslight and Coke Company) suggested that any smelling cookers noticed were made before the days of gas and air adjustment, when stoves were sent out for 1-inch pressure, whereas now the pressures were generally a good deal more than this, so that incomplete combustion ensued. If the gas-flame was properly regulated, there should be no smell in this way; but they could not help the action of cold iron.

Mr. D. J. Winslow (Lea Bridge) thought the chief trouble was that they did not get complaints from consumers until it was almost too late. In respect to churches, &c., a good plan was to offer to fit up an incandescent system, and charge for it the same amount as was paid under the old installation for gas, until the amount saved in consumption had paid for the outlay on the fittings. As to the remodelling of fires in the manner indicated by Mr. Creasey, the idea was excellent; but he took it there was no profit on the work.

Mr. W. J. Liberty (London) cited the case of a big building where many meetings were being held, which had for years been heated by gas in an unsatisfactory manner. This, he said, had lately been put right; but he thought it was somebody's duty to have called attention long ago to the fact that a more economical system, and one giving greater heat, could be adopted.

Mr. D. C. Cross (Lea Bridge) pointed out that efficiency did not altogether depend upon the outside department. Those on the works could help a great deal by keeping the constituent parts of the gas as constant as possible. The percentage of water gas should be kept as even as practicable; but in some places, of course, a constant proportion was not possible. Then the pressure should be kept equal (say) up to midnight, so as to avoid serious fluctuations during the daytime.

Mr. E. G. Stewart (Gaslight and Coke Company) said it was a burning question now as to how far gas companies should maintain apparatus. They ought to arrange their conditions so that the apparatus should work with a minimum amount of maintenance. Some appliances, of course, needed periodical attention; and it seemed to him advisable that gas companies should not sell these, but keep them on hire, so that they would always have some amount of control over them.

The President said that, bearing on the subject of efficiency in its relation to commercial success, it had occurred to him that a few remarks appertaining to scientific *versus* commercial efficiency would be of some interest. They were somewhat theoretical; but they brought out a rather important principle. Though cost was by no means the only factor to be taken into account when drawing up a given scheme, it was in these days a

very important one, and must not be overlooked. For purposes of illustration, let them take a lighting installation. The charges that went to make up the total cost might for this purpose be regarded as: (1) Cost for energy; and (2) cost for maintenance, and interest and depreciation. In deciding upon the units for a lighting installation, they had at the present time the choice of a variety of lamps varying in efficiency from 2 to over 60 candle-hours per cubic foot of gas consumed. The low efficiency referred, of course, to the now almost obsolete flat-flame burner. Efficiencies up to 120 candle-hours per cubic foot were obtainable if oxygen was used instead of air. Now, they would assume as a basis a certain number of candle-hours. The quantity of gas required for this purpose might be readily calculated if the efficiency of the light source was known; and knowing the price per 1000 cubic feet, the cost for gas was easily obtained. The sum of the other charges—namely, maintenance, interest, and depreciation—would not depend upon the price of gas, but would tend to increase with increase in efficiency. The relation between the two charges (1) and (2) which went to make the total cost of the installation would be as follows: The charge for gas would decrease as the efficiency increased; the charge for maintenance, &c., would tend to increase as the efficiency increased. If the two charges were added together for the various efficiencies, they would find that their sum would first decrease as the efficiency rose; but at a certain point it would reach a minimum, after which it would increase. The efficiency at which the sum of the charges was a minimum was, of course, the best commercial efficiency as far as £ s. d. was concerned. If the best "commercial efficiency," or cheapest efficiency, were determined for various prices of gas in the manner just described, its value would be found to decrease as the price of gas fell—assuming the charge for maintenance, interest, and depreciation to remain constant. On the other hand, if the price of gas was assumed to remain constant, a decrease in the charge for maintenance, interest, and depreciation would cause the point of best "commercial efficiency" to rise. The position might be briefly stated as follows: The point of best "commercial efficiency" fell as the price of gas was lowered, but rose as the charges for maintenance, interest, and depreciation were lowered. This, he thought, was the inference to be drawn: They had, on the one hand, the gas manufacturing engineer doing his best to supply the consumer with gas at the cheapest possible rate, and, on the other, the lamp manufacturer doing his best to obtain the largest possible quantity of light from a cubic foot of gas. As they had seen, these influences would be antagonistic—*i.e.*, the low price for gas would favour the adoption of low luminous efficiencies, provided the cost for maintenance, &c., were not reduced at the same time. As the latter items were largely in the hands of the sales departments, it would appear that the inspector, to a great extent, held the key to continued progress in gas lighting. He brought the otherwise antagonistic tendencies of the gas manufacturer and lamp maker into line, and upon him depended the possibility of utilizing to the full the combined efforts of the two. By continued improvement in organization and methods, and the adoption of appliances best suited for the unsympathetic conditions of everyday work, the cost of maintenance, &c., would be reduced; and the result would be to prevent the commercial estrangement of the two important elements of development—namely, cheaper gas and higher luminous efficiencies. It had been said that dividends were made in the retort-house; but though this might be quite true, they might easily be lost again if the sales departments failed in their duties. These remarks applied equally well to all applications of gas, domestic and industrial—and, for that matter, to all forms of commerce and industry. They in the gas industry were not yet in a position to disregard the highest available efficiencies; but as these would undoubtedly continue to rise, and the price of gas continue to fall, sustained efforts towards higher efficiency in the sales departments became imperative.

Mr. CREASEY said he must cut his replies short, as it was getting late, and Mr. Frost's discussion had yet to take place. If a cooker was fixed, cleaned, and maintained properly, there would be no smell. Any cooking appliance kept dirty would smell. There would also be no flame so long that it should get round a kettle; but he failed to see how they were going to prevent a housewife putting a small saucepan on a big ring. Mr. Carpenter's query involved questions of policy and cost; but all appliances he would like to see maintained—even a boiling-ring. He would like to see free maintenance for all apparatus—perhaps other than lighting, and in this case he would like only mantles to be charged for. Cooking-stoves, it seemed to him, should be inspected twice a year; while gas-fires ought to do with one inspection—in the autumn, as far as possible. But with the latter a second inspection would be made if a complaint was received. Anthracite stoves were an abomination, and should be easy to fight. Carbon monoxide appeared largely in their products; and they were absolutely poisonous. The idea was to get slow combustion; and for this they must have bad ventilation. As regarded the opportunities of increasing efficiency, plenty arose. Of course, inspectors could not work day and night; but even fitters saw things which should not be, and passed them. He found that the 7s. he had quoted would pay for delivering a remodelled stove and taking back the old one—which would in turn be remodelled and sent out to someone else. The point that had been raised with regard to the works helping the outside department, was an important one. It was most necessary that an even pressure should be maintained; but however good the gas, and however good the pressure, if the appliances were imperfect they would not get along.

CONDENSATION OF COAL GAS.

Mr. F. A. FROST (of the South Metropolitan Gas Company), in opening a discussion on this subject, remarked that, next to carbonization, condensation was the principal process in gas manufacture, and upon its satisfactory accomplishment depended to a large extent the economy of the subsequent operations. The object of condensation should be to cool the gas and bring it to a suitable condition for the following processes of both wet and dry purification. But with the systems in general use, it could not be said that this aim was attained to any high degree of perfection, owing to difficulties, some of which had been solved by the more scientific methods of production of to-day, while others of even more troublesome nature had taken their place. Before noticing the present-day difficulties, he devoted a few moments to a description of those of the period during which some of the systems still employed were introduced—when temperatures were lower, cannel was used, and gas of 20 candles and upwards was quite common. Reference was made by the speaker to the earlier hydraulic systems of condensation of the Livesey and Morris and Cutler type, which, he pointed out, while being more efficient than the air-cooled systems in the summer months, allowed the gas at other periods to be maintained at any desired temperature by merely adjusting the rate of flow of the water in which the condensing mains were immersed. There were, he continued, differences of opinion as to the advisability of prolonging the operation of cooling gas. Some people urged that the tar-fog present in the gas exerted an injurious influence by its solvent action on the illuminants, and that, though gradual cooling was desirable, it was an advantage to accelerate the operation, in order to effect the separation of the tar-fog from the gas as soon as possible. Others, however, held that the longer these tar-oils were kept in contact with the gas—especially at a high temperature—the greater was the solvent action exerted upon the naphthalene vapour present, and that ultimately they removed it altogether with the tar; the illuminating constituents of the gas itself not being affected to any considerable extent. With the more scientific carbonizing methods now prevailing, the general practice was to produce, at much higher temperatures than formerly, a greater yield of gas of a much lower grade; and, in condensing gas like this, experience showed that it could be subjected to all ordinary temperatures without any injurious effects, and that there were many advantages to be gained by reducing its temperature much lower than was previously possible. For this purpose, the tubular vertical type of hydraulic condenser was now generally favoured, as it possessed many advantages over the horizontal forms—some of these being in the matter of ground space occupied, easier drainage of the condensed products, and smaller area combined with greater efficiency. So permanent was the character of the low-grade gas now made (it being unaffected by sudden changes or extremes of temperature), that its condensation would be quite simple to effect, were it not for the troubles arising from the naphthalene deposits found in the condensers. The higher carbonizing temperatures produced more naphthalene; while the quantity of light tar-oils capable of effecting its removal with the condensed products was reduced. This resulted in the deposition of naphthalene in the solid form during the later stages of cooling—thus leading to many troubles in this and subsequent portions of the plant. One method of dealing with these deposits of naphthalene was to make the condensers reversible; but the success of this plan depended upon the type of plant employed, as well as the temperature of the gas entering the condensers. The higher the temperature, the greater was the amount of tar-fog present. This fog would, on accretion, and assuming its liquid form, effect the solution of the naphthalene, and remove it with the condensed products. This method permitted of continuous working with the same set of condensers, and did away with the necessity for cleaning out obstructions by hand or steaming. The most striking departure from usual condensation practice was the system devised by Mr. Charles Carpenter, which, in addition to the customary objects of the process, aimed at the removal from the gas of the naphthalene. These condensers were of the vertical tubular hydraulic type, arranged on the reversible plan, and presented to the gas a large area of cooling surface—the water flowing in an opposite direction to the gas. The gas passed direct from the foul main to the exhauster, and then into the condenser, where its temperature was quickly reduced from about 140° Fahr. to within 2° of that of the water used, causing the naphthalene vapour present to assume the solid form. The naphthalene was then absorbed by tar, which was constantly circulated—entering at the tops of the tubes, and thoroughly coating all the surfaces exposed to the gas. By this means, the naphthalene was reduced to a negligible quantity. The gas was next passed into a Livesey washer, so as to remove the last traces of tar-fog; and it was then in an ideal condition for the ammonia purification process. It had been proved that intimate contact with the cold tar did not affect the illuminants in the gas. In fact, the employment of tar for the removal of naphthalene in this manner had given highly satisfactory results. It rendered the condensers self-cleansing; while naphthalene obstructions in the plant were a thing of the past.

The PRESIDENT said this subject had a distinct bearing on the question of efficiency, as regarded satisfying the consumer,

because if they did not look after the naphthalene on the works there would be dissatisfaction on the part of their customers.

Mr. E. G. Stewart (Gaslight and Coke Company) remarked that Mr. Carpenter, in his system, removed the whole of the naphthalene in the gas, and put it in his tar. It was well known that naphthalene in the tar caused great difficulty at the tar-works. Did the South Metropolitan Company have any trouble in dealing with the naphthalene in their tar?

Mr. G. F. Cox (Commercial Gas Company) asked if the tar was treated in any way from the point of view of specific gravity. Of what specific gravity was the tar that was pumped into the condenser? Had Mr. Frost had any experience of absolutely freezing the gas—passing it through a refrigerator, to bring the naphthalene out, and put an end to any fear of a variation in temperature in any part of the works resulting in naphthalene?

Mr. T. S. F. Gibson, on being called upon, said he had not come to the meeting with any idea of speaking, but to listen. It seemed to him that Mr. Frost had dealt with the matter in an excellent manner, and had well described Mr. Carpenter's system. He did not think Mr. Field had very much trouble with naphthalene at Ordnance Wharf—in fact, he was probably rather pleased to have it than otherwise. The only trouble they did have was that they liked to get the gas to the condensers right up to the 140°—to keep the heat at this temperature. If the gas did not enter the reversible condensers at high temperatures, a lot of the usefulness of the apparatus was lost.

Mr. D. J. Winslow (Lea Bridge) said he would be glad to have some idea of the reduction in the number of complaints in consequence of the plant being used in this way.

Mr. J. Hewett (South Metropolitan Company) remarked that naphthalene was a bugbear; and if it were possible to remove absolutely the last trace, it would be an advantage. This, he was afraid, could not be done by any system at present. To his mind, what the reversible type of condenser had done was to attack the subject in its infancy. It put an end to a considerable amount of trouble on the works. Other systems might perhaps prevent the naphthalene from getting to the streets, but they did not prevent the choking-up of mains and plant on the works. They not only wanted to avoid trouble on the district, but if they could avoid it on the works so much the better; and there was little doubt the condensers referred to would do this.

The President said it was far the best to keep the naphthalene on the works. As to the question of excessive cooling, he should think it ought, on the whole, to be a good thing. They had to remember that the removal of naphthalene from the gas was a dual operation. It was due in part to the absorption of the solution in the tar, which had a distinct solvent action on the naphthalene. On the other hand, they applied the principle of excessive cooling, which made the naphthalene come down in the solid form. There were the two separate actions going on together. He believed he was right when he said that, the cooler the tar the less was its solvent capacity. With the excessive cooling system, though they increased the efficiency from the point of view of the cooling effect, they reduced the efficiency of the tar as a solvent. He was not aware whether this was actually the case in practice. At 50°, the naphthalene required to saturate the gas would be 7 grains per 100 cubic feet. As, however, the gas got warmer, the amount of naphthalene it could carry as a vapour increased very much. If the gas should leave the works at 80°, it might possibly contain 42 grains per 100 feet. At 100°, it might contain 117 grains of naphthalene per 100 feet; and at 120°, 276 grains. Supposing the gas leaving the works at 80°, with 42 grains of naphthalene per 100 feet, when it got into the mains was cooled down to 50°, then its carrying capacity would be reduced to 7 grains—a difference of 35 grains, which would go towards blocking-up the mains and services. It seemed to him that the drastic action Mr. Frost had referred to was a very good principle. If they could cool the gas to 50° before it left the works, it would not be likely that it would at any time go lower—which would mean that no naphthalene would come out. But in doing this, they were cooling the tar at the same time, and reducing its solvent power; so perhaps what they gained in one way they lost in another.

Mr. G. M. Gill said he might make a remark or two on one aspect of the question—and that was, the amount of cooling and condensation that took place in the ascension-pipes. With six-hour charges of 6 cwt. in a through retort, the gas was given off at a good deal higher temperature than in (say) a 12 cwt. charge put in for twelve-hours' carbonization. With the six-hour charge, his Company used to find that the gas would reach the mouthpiece at a temperature of something between 700° and 1000° Fahr. With the larger charge of twelve-hours' duration, the gas was evolved at a much lower temperature; and it varied between (say) 500° and 750° Fahr. This being so, it passed up the ascension-pipe and reached the top at a lower temperature than had been the case with the smaller charges. He found that with the small charges the gas at the bridge-pipe would be roughly 250° Fahr.; and with the larger charge it dropped to about 150°. The effect of this was that the gas at the lower temperature of 150° would not carry all the tar over into the hydraulic main; and the consequence was that the tar flowed down the ascension-pipe, and a certain amount was undoubtedly lost. He did not know whether anyone else present had noticed this point. If so, it would be extremely interesting to hear a few words on the matter.

Mr. Frost, in replying to the discussion, remarked that Mr. Gibson had replied to the question asked by Mr. Stewart. Apart from this, however, he would like to emphasize the fact that, though the South Metropolitan Company had a tar-works of their own, first and foremost they were manufacturers of gas. Mr. Cox had alluded to the specific gravity of the tar. It was just the ordinary tar, without any special preparation. With regard to freezing gas, he believed it had been tried; but the question at present was one of cost. Whether it would be worth doing, remained to be seen. Mr. Winslow asked about the complaints. He had no knowledge of the numbers of these; but it was necessary to bear in mind that the whole of the mains of the Company were coupled together, and that all the works were not yet fitted up on the reversible condenser principle. There remained something like 50 per cent. of the plant to be dealt with. There would also be the remains of the naphthalene in the mains before the apparatus was put into action. He quite agreed with Mr. Hewett that the proper way to deal with a trouble was to "nip it in the bud." This was just what the Carpenter system did. The temperature of the tar, which Mr. Clark had alluded to, was variable. It might be warmer in some parts than in others. A temperature of 80° was never reached in this system in summer. As to Mr. Gill's query with reference to tar coming back to the retort, it seemed to him that this was a question of the evenness of the retort temperature right up to the mouthpieces and the placing of the charge. If a retort was badly charged, the tar would condense in the ascension-pipe and run down. This trouble had been rectified by the better heating of the retorts and the more exact placing of the charge. One did not want to place more coal near the mouthpiece than the retort was capable of burning off.

The proceedings concluded with a cordial vote of thanks to Mr. Creasey, Mr. Frost, and Mr. Clark—this being passed on the proposition of Mr. Winslow, seconded by Mr. Chandler.

MIDLAND JUNIOR GAS ASSOCIATION.

A Meeting of the Association was held on Saturday afternoon, at the City of Birmingham Technical School—Mr. R. J. Rogers, the President, in the chair.

New Honorary Members.

The President, at the opening of the proceedings, stated that since the previous meeting two honorary members had been elected. One was Mr. J. W. Rendell Baker, of Malvern, who had always taken a keen interest in the Association. The members had visited Malvern; and Mr. Baker had attended several of their meetings. The other was Mr. E. W. Smith, who had been appointed Chief Chemist to the Birmingham Corporation Gas Department. Mr. Smith was to read a paper before the Association on "High-Pressure Gas" later on in the session.

Forthcoming University Lectures.

The Hon. Secretary (Mr. W. J. Pickering) read a letter from Professor F. W. Burstall, concerning the dates of the next two University lectures. These are both to be on a Thursday—one on Feb. 15 in the English Theatre, and the other on March 14 in the Medical Theatre, of the University Buildings in Edmund Street. He said he had also received a letter from Mr. A. R. Warnes (who has left the district) handing in his resignation as a member of the Council. To serve in his place, the Council had appointed Mr. T. H. Poulson, of Cannock.

Mr. J. Hewett said he would like to take this opportunity of thanking them for some time ago electing him an honorary member of the Association. He appreciated this very highly, and should hope for many years to be able to take part in the proceedings. He had the welfare of the Association deeply at heart.

The Distribution of Gas: Problems and Solutions.

Mr. James Hewett, Distributing Engineer to the City of Birmingham Gas Department, then read a paper on the "Distribution of Gas: Problems and Solutions;" and this, together with a report of the discussion to which it gave rise, will be found on pp. 288-96.

Gas-Fires for Tinning.—According to the "Ironmonger," attention has been directed by an American expert to an advantage which can be obtained in the tinning-shop by the substitution of gas-burners for coal-fire apparatus; his experience being based upon the production of tin wire goods. Formerly these were done in a large pot heated by coal. The metal was partly lead, and was intended to be kept at 600° Fahr. As the heat showed great variation by the tests of the pyrometer—often dropping to 500° and ess—a larger amount of tin was deposi ed up n the work than was desired. With tin at its present price, an even temperature of 600° Fahr. was desired to prevent a loss. The shape of the combustion chamber was therefore altered by bricking it up and lining it with asbestos millboard ¼ inch thick. The pot was 18 in. by 24 in., and 18 in. deep, of cast iron. Under this were two drilled pipe bunsen burners, with a capacity of about 200 cubic feet per hour. After heating-up in the morning (being lighted by the watchman from a pilot light at six o'clock), the bath was ready at seven, and held steady at 600° Fahr. all day on about 120 cubic feet of gas per hour. The average monthly consumption of gas was 25,000 cubic feet.

GUIDE-FRAMING OF A GASHOLDER.

By E. F. Miller, of the Camden (N.J.) Iron-Works.

[Reprinted by "Progressive Age" from "Engineering News."]

A gasholder, being a bell or inverted bucket supported by the confined gas and floating in water, is in unstable equilibrium because the weight of the crown, or bottom of the bucket, is at the highest point. For this reason, and also for the purpose of resisting the overturning force of the wind, lateral support must be furnished to keep the bottom edge, or curb, approximately level with the surface of the water in the tank. As the gasholder rises and falls, these supports become guides.

The guiding of the bottom curb consists of rails secured to the inside of the shell of the tank acting as tracks for the rollers secured to the curb of the holder [see fig. 1].' The guides for the top curb rollers must extend above the tank, and the structure to maintain them in vertical lines, consisting of standards, struts, ties, and necessary details, is called the guide-frame. The base of this guide-frame is fastened to the top curb of the tank. In the case of a holder in a masonry tank, the standards are fastened to base-plates secured by foundation bolts built into the walls. In a steel tank, the standards are secured to the top curb of the tank, and also to the tank shell, by means of plates uniting them to the tank standards or column supports; the latter being bolted or riveted to the plates of the tank shell.

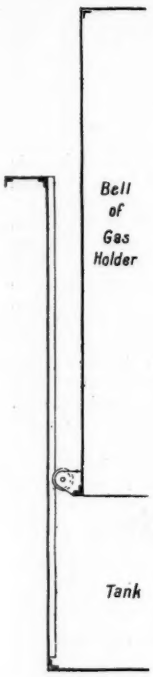


Fig. 1.—Bottom of Guide.

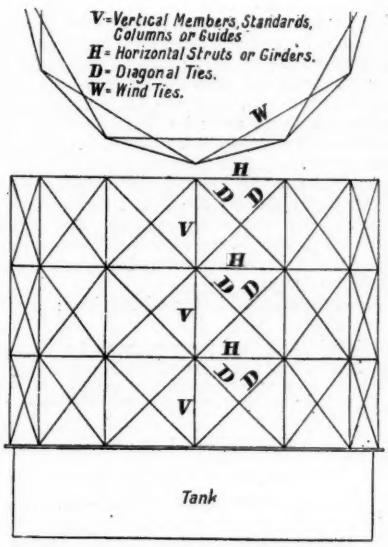


Fig. 2.—Guide Frame.

The guide-frame proper, lying entirely above the tank curb, consists [see fig. 2] of four kinds of members; (1) The vertical standards V (usually miscalled columns), which carry the guides; (2) the horizontal struts H (usually miscalled girders); (3) the diagonal ties D in each rectangular bay; and (4) the wind ties W at the top, which help to preserve the geometrical figure.

Historical.

The older gasholders, consisting of a single lift working in a masonry tank, did not present a very large surface to the wind; so that a number of posts set up about the circle of the tank curb, tied together (sometimes) at the top, and carrying cast-iron guides, were sufficient as lateral supports. Being designed by architects, these guide-frames were usually constructed of cast-iron, in conventional and ornamental shapes. A round column with base and capital and shaft, strictly according to one of the classical orders, was the favourite, though rectangular columns, built of cast-iron plates bolted together, were frequently used. These plates were cast with exterior mouldings and with openings, all of graceful design, sometimes of Italian scroll work, sometimes of Gothic arches. As it was thought to be desirable to distribute gas at a pressure much less than the gasholder gave (unless built very flimsily), counterbalancing was applied; the counterbalance weights usually moving inside the hollow columns. The so-called girders which sometimes united the tops of the columns were, when of cast iron, usually made with a curved upper flange and an openwork web, which was designed with circles, fleur-de-lis, &c. Ornamental cast-iron urns were sometimes placed on top of the columns, and were filled with earth in which vines could grow.

Neither diagonal ties nor wind ties were used in these designs; and each standard resisted its transverse load by the moment of its own weight and by the resisting moment of its foundation-bolts. Though the posts or guide supports received no vertical load other than their own weight and that of the other parts of the guide-frame, they were given the architectural name of "columns," which is still more or less used when speaking of the corresponding parts in modern structures. Likewise the horizontal members which were used to unite the tops of the columns were called "girders," though they supported no transverse load other than their own weight; and this name is still more or less used.

As the building of telescopic gasholders came into vogue, and more attention was paid to efficiency of construction, round tapered columns were made of wrought-iron plates rolled into sections, which were united by inside butt-straps having rivets countersunk on the outside. After painting, the appearance of such columns was similar to the round ones of cast iron. The girders were also made of wrought iron, generally of the flat type, having angles in the top and bottom chords; these angles being sometimes covered by plates. The chords were connected by flat lattices. Diagonal ties of round iron also began to be used between the columns.

Finally, with the advent of multiple-lift gasholders working in steel tanks, the design of the guide-frame was changed to the steel structure riveted together, and having diagonal ties and wind ties, which is now generally adopted.

Calculating the Loads on Guide-Frames.

The forces which a guide-frame must resist are due to the pressure and impulses of the wind, to the unbalanced snow load, and to the unbalanced weight of the bell. As a gasholder is designed to be of uniform weight on its circumference, the unbalanced condition of the bell is purely accidental, and cannot be estimated. Its effect is therefore neglected, excepting in so far as it is covered, together with other uncertainties, by the so-called factor of safety. The snow load, when uniformly distributed over the crown, does not augment the forces which must be resisted by the strength and stiffness of the guide-frame, but when accumulated on one side it throws the gasholder bell out of balance, and tends to distort the guide-frame. When the snow is on the lee side of the crown, it adds a certain amount to the estimated wind load. The usual assumption of unbalanced snow load is 5 lbs. per square foot on one-fourth of the crown area [see fig. 3]; the centre of gravity of the unbalanced load being assumed to be a point located two-thirds of the distance from the centre of the crown to its outer edge.

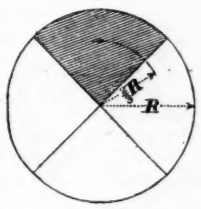


Fig. 3.—Assumed Snow Load.

The wind is the most powerful distorting force to be considered. The guide-frame of a gasholder which is either fully or partially inflated is not in danger of distortion, provided its members are strong enough to properly resist the direct load. But a guide-frame standing by itself is in great danger of accumulation of loads due to vibration caused by the impulses of the wind; and on this account the details of the joints, as well as the sections of the members, are of great importance. The impulses of the wind are not of large extent or duration, and will not overcome quickly the inertia of a relatively large and heavy gasholder. Further, these impulses may succeed each other with considerable frequency; but it is improbable that they will hit the same spot, or hit from the same direction. But in a guide-frame standing alone, a succession of blows may have a cumulative effect on short vibrations, setting up local strains in excess of results of static calculations. When repeated and prolonged, these local excessive strains are more destructive of details than the maximum calculated strains. An efficient design of the wind ties at the top of the guide-frame will largely promote the preservation of its figure and shape, and reduce the amplitude of vibrations.

A large guide-frame may be considered to be a relatively thin cylinder, secured at the bottom and kept in shape at the top; but near the middle the tendency to change the shape is resisted only by the horizontal struts considered as rings, and the vertical standards considered as beams. The struts being (say) only 30 inches deep horizontally, and the standards perhaps only 48 inches deep radially, it is readily seen that the wind-tie system at the top should be deep, sufficient, and efficient.

Many guide-frames are built without wind ties; but a sufficient rigidity of the top of the frame can be ensured more economically by the use of wind ties than in any other manner. Here it must be remembered that it is impossible to load and test a gasholder frame as a bridge or floor may be tested; and it is not probable that one in a thousand frames is ever subjected to a load as severe as is assumed in the calculations. For this reason, guide-frames of defective design may have a long and useful life and be repeated, having the approval of experience.

There is a design of shortened frame, permitting one or two sections of the gasholder to rise above the top. In this design the top strut or girder is made wide—providing a horizontal girder of considerable depth to stiffen the frame and to keep the holder in shape when the wind pressure against the upper section tends to unbalance loads and distort the holder rings.

A horizontal wind load of 32 lbs. per square foot on a normal

plane surface, or 16 lbs. on the diametral projection of a cylindrical surface, which corresponds to an observed velocity of about 115 miles per hour (or a corrected velocity of about 90 miles per hour, according to tables of the United States Weather Bureau), exceeds the records at any observing station in America.

Calculation of Loads and Stresses.

To avoid the construction and handling of long formulæ with many terms, which must be carried along, an example will be taken, and the formulæ developed along with the actual calculation of loads.

Consider a four-lift gasholder, of about 3,700,000 cubic feet capacity, of these dimensions:

	Diameter. Ft.	In.		Depth. Ft.	In.
Inner lift	181	5	..	35	0
Second lift	184	1	..	35	6
Third lift	186	9	..	35	4
Outer lift	189	5	..	35	10
Tank	192	0	..	36	0

Guide-frame: 20 standards, 142 feet high, with five rings of horizontal struts, Each lift is guided on the standards by 20 goosenecks or top brackets, each carrying one radial and two tangential rollers. To determine the general loads on the guide-frame, it is sufficient to calculate the total load at the top of each lift; but to design the section of standards, the maximum load on the individual rollers must be ascertained. This is figured as below.

All the rollers standing at an angle of less than 60° with the direction of the wind, and so located that any horizontal movement caused by the wind will be towards the guide, are assumed to be effective, and to carry loads proportional to the cosines of the respective angles with the wind direction. The effective resistance of these rollers to horizontal translation (due to their reaction against the guide-frame) is also proportional to the cosines of the angles. Therefore the relative effective resistance offered is proportional to the squares of the cosines of the respective angles with the wind direction. It is evident that the radial roller directly in line with the wind and the tangential rollers at right angles will carry the greatest loads. [See fig. 4.]

Radial	1	cos² 0 deg.	=	1·00
,,	2	,, 18 ,,	=	1·81
,,	2	,, 36 ,,	=	1·31
,,	2	,, 54 ,,	=	0·69
Tangential	2	,, 0 ,,	=	2·00
,,	4	,, 18 ,,	=	3·62
,,	4	,, 36 ,,	=	2·62
,,	4	,, 54 ,,	=	1·38
Total				14·43

It is thus seen that the total horizontal load at any ring of goosenecks divided by 14·43 will be the maximum roller load, which is also the maximum central load a section of standard must carry, either radially or tangentially.

The roller pressures are found as follows: The horizontal load on the goosenecks at the top of the inner lift is:

	Pounds.
Due to snow— $\frac{\text{Area of crown} \times 5}{4} \times \frac{\text{two-thirds of radius}}{\text{Half net depth of four lifts}} = \frac{25{,}850 \times 5 \times 60{\cdot}5}{4 \times 68{\cdot}6} =$	28,500
Due to wind— Diameter of inner lift × 16 × half net depth of inner lift = 181·4 × 16 × 16·7 =	48,500
Total horizontal load on goosenecks =	77,000
The maximum load on the individual rollers at the top of the inner lift is 77,000 ÷ 14·43 =	5,300
The horizontal load on the goosenecks at the top of the second lift is— Diameter of inner lift × 16 × half net depth of inner lift + diameter of second lift × 16 × half net depth of second lift = 48,500 + (184·1 × 16 × 17) = 48,500 + 50,100 =	98,600
The maximum load on the individual rollers at the top of the second lift is 98,600 ÷ 14·43 =	6,800
The horizontal load on the goosenecks at the top of the third lift is 50,100 + 186·8 × 16 × 17 = 50,100 + 50,800 =	100,900
The maximum load on individual rollers at the top of the third lift is 100,900 ÷ 14·43 =	6,900
The horizontal load on the goosenecks at the top of the outer lift is 50,800 + 189·4 × 16 × 17·9 = 50,800 + 54,200 =	105,000
The maximum load on individual rollers at the top of the outer lift is 105,000 ÷ 14·43 =	7,300

In transferring the figured loads from the goosenecks to the guide-frame, the front flange of the standard is considered as carrying the maximum tangential roller load as a beam loaded at the centre.

A standard 15-inch I-beam, 28 feet long, weighing 42 lbs. per foot, is stressed to a maximum of 16,000 lbs. per square inch by a centre load of 11,200 lbs. The maximum figured load of 6900 lbs. (third lift) is sufficiently inside this figure to produce a maximum stress of 9900 lbs. per square inch. The figured deflection will be about 0·43 inch. As the I-beams are firmly united at their ends by flange butt-straps (forming continuous beams), the stress and deflection are probably much less than the figures indicate.

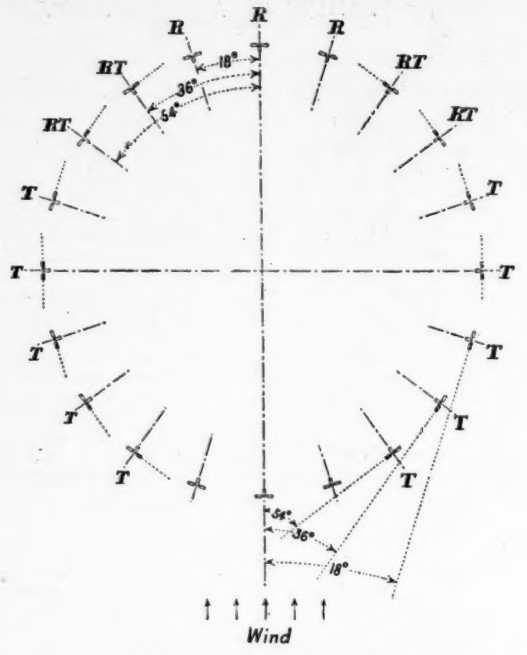


Fig. 4.—Diagram of Guide Rollers.

In order to ascertain the maximum stresses in the diagonal ties, horizontal struts, and the back flanges of the standards, the gooseneck loads must be distributed to the panel joints. This distribution is made by considering the sections of standards as beams (supported at the panel points) upon which the loads act. In addition to the loads from the goosenecks, there are further slight loads due to the direct pressure against the standards, which present surfaces (assumed to be 4 feet wide) normal to the wind. The sum of both loads will give the maximum horizontal shear which is considered as being resisted by the diagonal ties. (Refer to fig. 5.)

Load distributed to top of first bay:

	Pounds.
Horizontal load from goosenecks	77,000
Horizontal loads from wind on standards— $\frac{2 \times \text{length of first section} \times \text{width} \times 32}{2} =$ $2 \times \frac{30 \times 4}{2} \times 32 =$	3,800
Total maximum horizontal shear	80,800

Load distributed to top of second bay:

Maximum horizontal shear from above	80,800
Horizontal load from goosenecks (98,600 × 264) ÷ 336 =	77,500
Horizontal load from wind on standards— $2 \times \frac{\text{length of first section} \times \text{width}}{2} \times 32 +$ $2 \times \frac{\text{length of second section} \times \text{width}}{2} \times 32 =$ $3800 + 2 \times (28 \times 4) \div 2 \times 32 = 3800 + 3600 =$	7,400
Total maximum horizontal shear	165,700

Load distributed to top of third bay:

	Pounds.
Maximum horizontal shear from above = 165,700 + 98,600 − 77,500 =	186,800
Horizontal load from goosenecks = (100,900 × 178) ÷ 336 =	53,500
Do. from wind on standards = 3600 + 2 × $\frac{28 \times 4}{2} \times 32$ =	7,200
Total maximum horizontal shear	247,500

Load distributed to top of fourth bay:

Maximum horizontal shear from above = 247,500 + 100,900 − 53,500 =	294,900
Horizontal load from goosenecks = (105,000 × 95) ÷ 336 =	29,700
Do. from wind on standards = 3600 + 2 × (28 × 4) ÷ 2 × 32 =	7,200
Total maximum horizontal shear	331,800

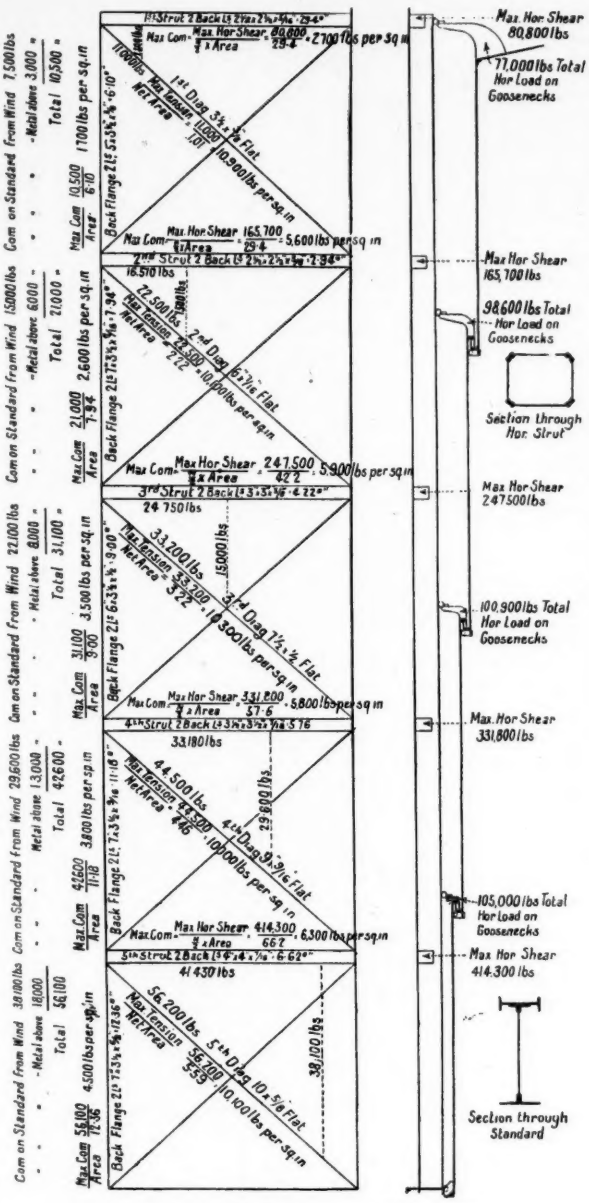

Max Hor Shear 80,800 lbs
77,000 lbs Total Hor Load on Goosenecks
Max Hor Shear 165,700 lbs
98,600 lbs Total Hor Load on Goosenecks
Section through Hor. Strut
Max Hor Shear 247,500 lbs
100,900 lbs Total Hor Load on Goosenecks
Max Hor Shear 331,800 lbs
105,000 lbs Total Hor Load on Goosenecks
Max Hor Shear 414,300 lbs
Section through Standard

Fig. 5.—Strain Diagrams and Holder Lifts.

Load distributed to top of fifth (lower) bay:

Maximum horizontal shear from above = 331,800
+ 105,000 − 29,700 . . . . . = 407,100
Horizontal load from wind on standards = 3600
+ 2 × (28 × 4) ÷ 2 × 32 . . . . . = 7,200

Total maximum horizontal shear . . . 414,300

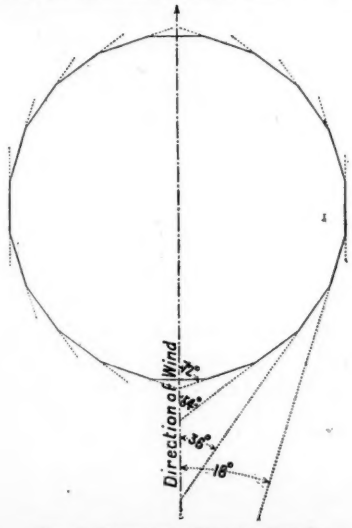


Fig. 6.—Diagram of Bracing Panels.

The guide-frame acts, as a whole, similarly to a hollow cylinder fixed at its lower end, and loaded as a cantilever beam. One diagonal tie in each bay (excepting those which may happen to stand in planes normal to the wind) is active as a tension member. The horizontal component of the load which each diagonal tie receives is proportional to the cosine of the angle of its plane with the direction of the wind; but its resistance in a direction parallel to the wind is also proportional to the cosine of the angle. Therefore the relative effective resistance of the diagonal tie to the horizontal shear is proportional to the square of the cosine of the horizontal angle. It is evident that the diagonal ties which stand in planes parallel to the wind will receive the greatest loads. (Refer to fig. 6.)

2 cos² 0 deg.	=	2·000
4 ,, 18 ,,	=	3·618
4 ,, 36 ,,	=	2·618
4 ,, 54 ,,	=	1·382
4 ,, 72 ,,	=	0·382
Total . .		10·000 = ½ *N*

It is thus seen that ½ *N*, or half the total number of standards divided into the total maximum horizontal shear, will give the horizontal component of the greatest load on any diagonal tie.

Horizontal component of maximum load on first diagonal tie, 80,800 ÷ 10 = 8080 lbs.; do. on second do., 167,500 ÷ 10 = 16,750 lbs.; do. on third do., 247,500 ÷ 10 = 24,750 lbs.; do. on fourth do., 331,800 ÷ 10 = 33,180 lbs.; do. on fifth do., 414,300 ÷ 10 = 41,430 lbs.

The direct load thrown on each diagonal tie is the resultant of the horizontal and vertical components as determined by its vertical angle. These resultants are readily ascertained graphically, and are given in fig. 5. The sections selected and the resulting unit-stresses on the diagonals are:

First bay, 3½ in. × ⅜ in. flat—
$\frac{\text{Maximum tension}}{\text{Net area}} = \frac{11{,}000}{1{\cdot}01} = 10{,}900$ lbs. per square inch.

Second bay, 5 in. × 7-16ths in. flat—
$\frac{\text{Maximum tension}}{\text{Net area}} = \frac{22{,}500}{2{\cdot}22} = 10{,}100$ lbs. ,, ,,

Third bay, 7½ in. × ½ in. flat—
$\frac{\text{Maximum tension}}{\text{Net area}} = \frac{33{,}200}{3{\cdot}22} = 10{,}300$ lbs. ,, ,,

Fourth bay, 9 in. × 9·16ths in. flat—
$\frac{\text{Maximum tension}}{\text{Net area}} = \frac{44{,}500}{4{\cdot}46} = 10{,}000$ lbs. ,, ,,

Fifth bay, 10 in. × ⅝ in. flat—
$\frac{\text{Maximum tension}}{\text{Net area}} = \frac{56{,}200}{5{\cdot}59} = 10{,}100$ lbs. ,, ,,

The maximum load on any horizontal strut is the horizontal component of the maximum load on the diagonal tie lying in the same bay, which is equivalent to the total maximum horizontal shear divided by ½ *N*. The sections adopted and the resulting unit-stresses are:

First bay, two back angles 2½ in. × 2½ in. × 5-16ths in.—
$\frac{\text{Total maximum horizontal shear}}{\frac{1}{2}N \times \text{area of two back angles}} = \frac{80{,}800}{10 \times 2{\cdot}94} = 2700$ lbs. per sq. in.

Second bay, two back angles 2½ in. × 2½ in. × 5-16ths in.—
$\frac{\text{Total maximum horizontal shear}}{\frac{1}{2}N \times \text{area of two back angles}} = \frac{165{,}700}{10 \times 2{\cdot}94} = 5600$ lbs. ,, ,,

Third bay, two back angles, 3 in. × 3 in. × ⅜ in.—
$\frac{\text{Total maximum horizontal shear}}{\frac{1}{2}N \times \text{area of two back angles}} = \frac{247{,}500}{10 \times 4{\cdot}22} = 5900$ lbs. ,, ,,

Fourth bay, two back angles 3½ in. × 3½ in. × 7-16ths in.—
$\frac{\text{Total maximum horizontal shear}}{\frac{1}{2}N \times \text{area of two back angles}} = \frac{331{,}800}{10 \times 5{\cdot}76} = 5800$ lbs. ,, ,,

Fifth bay, two back angles 4 in. × 4 in. × 7-16ths in.—
$\frac{\text{Total maximum horizontal shear}}{\frac{1}{2}N \times \text{area of two back angles}} = \frac{414{,}300}{10 \times 6{\cdot}62} = 6300$ lbs. ,, ,,

The struts are square, and consist of four angles—one in each corner—connected by lattice bars on all four sides. The least radius of gyration of the strut will be that of the combined section, though the loads are considered as being distributed over the back angles only. The maximum compressions (per square inch of area in the back angles only) for the various struts are well within the allowable unit-stress limits which correspond to the unsupported lengths divided by the least radii of gyration, as given in the handbooks.

When considering the standards as beams loaded radially, the maximum stresses will occur in the standard farthest from the centre on the lee side, due to the maximum radial roller load. The maximum stresses per square inch will occur in the second section (28 feet long); the standard being considered as a non-continuous beam loaded in the middle and supported at the ends. The front flange consists of a 15-inch 42-lb. I-beam and two 3½ in. by 2½ in. by 5-16ths in. angles; the gross area of the three shapes being 16·04 square inches. The back flange consists of two 6 in. by 3½ in. by 7-16ths in. angles; the gross area of the two shapes being 7·94 square inches, and the net area 7·12 square inches. The maximum bending moment is 6800 × 336 ÷ 4 = 571,200 inches-pounds. The distance from the centres of gravity of the front and back flanges to the neutral axis of the beam is 11·59 inches and 23·41 inches respectively.

Then—

$$23{\cdot}41 \times 7{\cdot}94 \times T + 11{\cdot}59 \times 16{\cdot}04 \times C = 571{,}200.$$

In the above equation T and C are the tension and compression, per square inch of gross area, in the back and front flanges respectively.

$$\text{But } C = \frac{11{\cdot}59}{23{\cdot}41} T; \text{ and by substitution we have—}$$

$$23{\cdot}41 \times 7{\cdot}94\, T + 11{\cdot}59 \times 16{\cdot}04 \times \frac{11{\cdot}59}{23{\cdot}41} = 571{,}200$$

whence

$$277{\cdot}9\, T = 571{,}200$$

or

$$T = 2055 \text{ lbs. and } C = 1017 \text{ lbs.}$$

B T is to be increased in the proportion of $\frac{7{\cdot}94}{7{\cdot}12}$ when the net area only is considered. Therefore the fibre stress (tension) in the back flange is 2300 lbs. per square inch net; that in the front flange (compression) remaining 1000 lbs. per square inch gross.

The greatest stresses due to the loads from the tangential rollers will occur in the standards at right angles to the direction of the wind, which fibre stresses have previously shown to be 9900 lbs. per square inch.

The greatest direct compression on a standard is due to the vertical component of the maximum load on the diagonal tie in the same bay, *plus* the weight of the metal in the structure above. This compression will take place in the same standard where the maximum load from the tangential roller occurs; but the compression due to the load from the diagonal tie is considered as taken by the back flange only, while the load from the tangential roller is considered as taken by the front flange only. The vertical components of the loads on the diagonal ties are readily ascertained graphically. They are given in fig. 5. The stress computation for the back flanges of the standards is as follows:

First bay, two back angles 5 in. × 3½ in. × ⅜ in.—

$$\frac{\text{Vertical component + weight of metal above}}{\text{Area of two back angles}} =$$

$$\frac{7500 + 3000}{6{\cdot}1} = 1700 \text{ lbs. per sq. in.}$$

Second bay, two back angles 6 in. × 3½ in. × 7-16ths in.—

$$\frac{15{,}000 + 6000}{7{\cdot}94} = 2600 \text{ lbs. per sq. in.}$$

Third bay, two back angles 6 in. × 3½ in. × ½ in.—

$$\frac{22{,}100 + 9000}{9} = 3500 \text{ lbs. per sq. in.}$$

Fourth bay, two back angles 7 in. × 3½ in. × 9-16ths in.—

$$\frac{29{,}600 + 13{,}000}{11{\cdot}18} = 3800 \text{ lbs. per sq. in.}$$

Fifth bay, two back angles 7 in. × 3½ in. × ⅝ in.—

$$\frac{38{,}100 + 18{,}000}{12{\cdot}36} = 4500 \text{ lbs. per sq. in.}$$

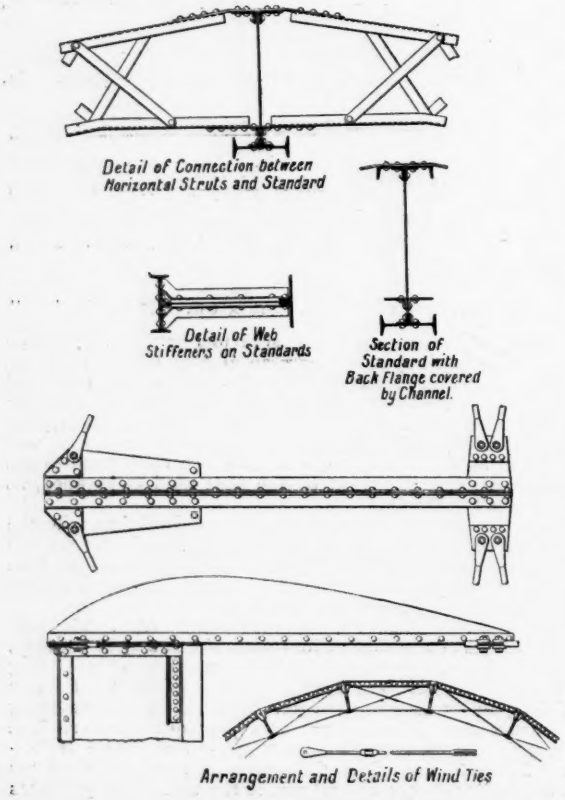

Detail of Connection between Horizontal Struts and Standard
Detail of Web Stiffeners on Standards
Section of Standard with Back Flange covered by Channel.
Arrangement and Details of Wind Ties

Fig. 7.—Types of Connections.

The least radius of gyration for any section of standard is that of the combined section of the back flange. The maximum compressions (per square inch of area in the back flanges only) for the various sections are well within the allowable unit-stress limits which correspond to the unsupported lengths divided by the least radii of gyration, as given in handbooks.

It is not possible to accurately calculate the stresses in the wind ties; but their dimensions are determined by judgment and experience. In the case under consideration, the ties consist of rods 1¼-inch diameter, having the ends upset for 1½-inch turnbuckles for adjustment. The arrangement is such [see fig. 7] that the effective depth of the wind-tie, considered as a stiffening ring, is about 10 feet.

In determining the loads at the bases of the standards, due to the overturning moment caused by the wind pressure, the guide-frame is considered as a cylinder having a diameter of 194 ft. 6 in. and a height of 142 feet; uniformly loaded at 16 lbs. per square foot on the diametral projection. The total wind moment will then be 194·5 × 142 × 16 × 71 = 31,375,200 foot-pounds. The loads at the bases of the various standards are proportional to their distances from the neutral axis; those lying farthest away receiving the greatest loads, and those lying on the neutral axis receiving none.

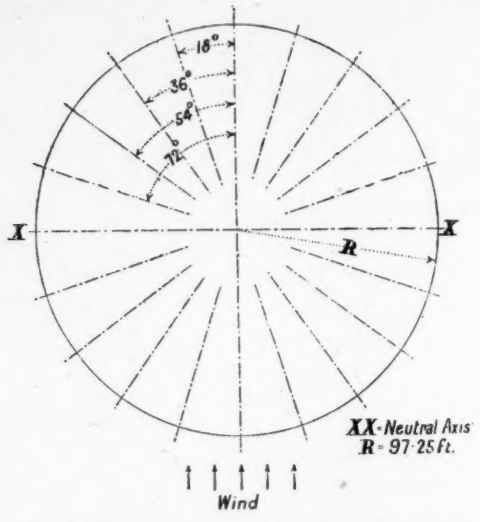


Fig. 8.—Diagram for Calculating Overturning Effect.

The effect of the resistance of each standard to the wind moment is also proportional to its distance from the neutral axis. Therefore the relative effective resistance offered to the wind moment is proportional to the square of its distance from the neutral axis. [See fig. 8.]

2	cos² 0° R	= 2·000 R
4	,, 18° R	= 3·618 R
4	,, 36° R	= 2·618 R
4	,, 54° R	= 1·382 R
4	,, 72° R	= 0·382 R
Total .	.	10·000 R

It is thus seen that the total wind moment, divided by the product of half the number of standards into the radius to the centre of the standard, will give the maximum load at the base of any standard—

$$31{,}375{,}200 \div (10 \times 97{\cdot}25) = 32{,}300 \text{ lbs.}$$

The loads in the standards on the lee side will produce pressure on the base; while on the windward side a lift will occur. Therefore the maximum pressure due to the wind moment and the load from the weight of metal in the structure above will be 32,300 + 18,000 = 50,300 lbs.; while the maximum lift will be 32,300 − 18,000 = 14,300 lbs.

General Remarks.

It has sometimes been contended that the standard supports, which are attached to the tank shell and located directly under the guide-frame standards, should extend to the tank foundation and rest thereon, in order to support the guide-frame properly. But, in view of the light loads actually existing at the bases of the standards, this is obviously unnecessary. It is usually sufficient that these supports should extend to about half the depth of the tank. The loads from the guide-frame are taken up by the rivets which attach the supports to the tank-shell; and there should always be a sufficient number of these to keep the shear and bearing much below the allowable limits, which is easily accomplished without extending to the bottom.

In order to secure rigidity of the guide-frame, all points between members should be made with rivets, with the single exception of the wind ties, where bolts and turnbuckles are permissible to accomplish adjustment. In especially high-grade frames, the tension in the lower diagonals should be kept within (say) 12,000 lbs. per square inch, in order to avoid such stretch as would allow of undesirable deflection at the top of the framing.

In addition to having sufficient strength to resist the loads applied by the tangential rollers, the front flange of the standard should

be of liberal width in order to limit deflection. The radial loads being comparatively small, only two sets of stiffeners (each set consisting of one angle on each side) are applied to the web of each section of standard. The use of these stiffeners to square the flanges when fitting-up in the shop, and to keep the standard in shape, is considered to be of more importance than their function as web stiffeners.

In no case should loads be carried by rivets in tension. When designing connections between struts and standards, or between diagonals and standards, it is necessary, in order to avoid subjecting rivets to tension, that any attachment to the web of the standard should be made by means of a gusset-plate which is continuous through the web; thus allowing of connecting the ends of the struts or diagonals coming on opposite sides of the web by rivets in shear through the gusset-plate.

In designing joints at the ends of a diagonal, sufficient rivets should be used to take up, at 10,000 lbs. per square inch shear, a load which could be produced by a stress of 16,000 lbs. per square inch on the net section of the diagonal. All other joints, especially at the panel points, should also be provided with an excess of rivets; the object being to have an abundance in case some should be loosened by racking and vibrations due to impulses of the wind. This excess of rivets also serves to keep the shear and bearing well within the allowable limits used in approved bridge construction.

Eccentric loading is avoided as much as possible; and where it does occur, it is of such slight extent as to be abundantly cared for by the so-called factor of safety. The centre line of riveted joints should be made to coincide with the centre of gravity of the section. This is easily accomplished in most cases—for instance, when the diagonals are flats; but when they are angles, it is necessary that rivets should be put through both legs, using a knee on the leg which is perpendicular to the gusset-plate.

As the loads which must be resisted by a guide-frame may be applied from any direction, it follows that all members of the same kind which are situated in the same section of the frame should be of identical design. For this reason, only those calculations are made which are necessary to determine maximum stresses. It is to be observed in the foregoing calculations that the entire snow load is assumed as being taken by the goosenecks at the top of the inner lift. Actually, part of this load will be taken by other goosenecks than those on the inner lift. But to determine how much would be impossible, because the rigidity of the gasholder bell—an uncertain quantity—would be involved. Therefore the above assumption is made, as it gives loads which are greater than those which would result from any other assumption.

Reversal of stresses will occur in some of the members of a guide-frame because the loads may be applied from any direction. But as in the most approved practice the stresses are kept within (say) 12,500 lbs. per square inch, when resisting, in addition to snow loads, those resulting from a wind pressure of 32 lbs. per square foot against a plane surface, and as storms violent enough to produce such a pressure will probably occur only once in a term of years, it is obvious that the matter of such reversal is of so little importance that it may be disregarded, and considered as being covered by the so-called factor of safety. In making calculations for actual design, it will usually be best to consider the diametral projection, on which the wind acts, as having a horizontal dimension equal to the diameter at the outermost parts of the standards, because this assumption will provide for all additional loads which may occur, due to the wind passing between the holder bell and the guide-frame, and its possible consequent entanglement with, and pressure upon, the various members.

When the flange of the standard is supported (opposite the panel points) by the struts, which have their front angles set near the ends and attached to the web as near the front flange as possible, in the manner indicated in fig. 7, and when the standards are otherwise made strong enough to carry to the back flange the loads transmitted by the gooseneck rollers, it is best that the diagonals should be located at the back flange. When they are so located, the connection between diagonals, struts, and standards is made by a single gusset-plate having all its rivets in direct shear. All the loads transmitted by the gooseneck rollers are thus finally carried through the gusset-plates at the panel points, and are there directly distributed to the various members which resist these loads. Furthermore, all stresses which are not finally neutralized by the weight of the guide-frame are transmitted to the standard supports by gusset-plates on the back flanges; the rivets being in direct shear. When the diagonals are placed close to the front flange, it is necessary, in order to secure clearance between them and the holder, to provide a greater number of standards than would be required if the diagonals were located at the back flange. This is an advantage in favour of the latter construction. Another is that the tension in the back flanges produced by the radial roller loads is either wholly or partly neutralized by the compression resulting from the pull of the diagonals; whereas the compression in the front flanges, produced by the radial and tangential roller loads, would be augmented by placing the diagonals near the front flange.

The use of box-shaped rather than I-shaped horizontal struts is advisable in large guide-frames, because, for the same weight of metal used, the least radius of gyration obtained in the box construction is much greater than in the other design. The choice of either latticed or web-plate standards is made according to considerations which appeal most to the purchaser. The latticed design is cheaper in first cost, and, in the author's judgment, fully as cheap in maintenance. Many purchasers prefer the web-plate design; thinking that it needs painting less often, and can be painted more easily. When the lattices are from $\frac{3}{8}$-inch to $\frac{1}{2}$-inch thick, a space of $\frac{3}{4}$-inch to 1-inch between the flange angles is sufficient for the insertion of a paint-brush, and, with proper inspection, the structure can be thoroughly painted. Lattices of such thickness will not lose, proportionately, so much from corrosion as web-plates $\frac{1}{4}$ inch or 5-16ths inch thick; and any thicker web-plate increases the first cost considerably. Furthermore, corrosion of flange angles on the surface next to the web-plate is not unknown in plate-girder construction; and when once started, the surface cannot be reached for cleaning and painting.

The choice of either flats, channels, or angles for use as diagonals is dependent upon circumstances. Flats are cheapest in first cost, because the price of the metal in them is generally less per pound than for the alternate shapes, and also because the shop and field work is less expensive. When either angles or channels are used, it is necessary, in order to properly distribute the stresses about the centre of gravity of the section, to use angle knees on the flanges. When the diagonals are extraordinarily long, it is advisable to use angles in order to prevent undue swaying in the wind.

The difficulty of keeping a guide-frame properly painted, with the consequent tendency to corrosion, makes it advisable not to use in its construction any metal thinner than $\frac{1}{4}$ inch; while for the more important members—such as the diagonals and back angles in the struts and standards—the metal should never be thinner than 5-16th inch in large guide-frames.

Types of Gasholder Guide-Frames.

The various methods of guiding gasholders may be classified as follows: (1) Steel frames braced and supplied with tension diagonals such as are now being considered. (2) Steel frames with diagonals which act alternately as ties and struts. (3) Steel frames with guides for tangential rollers only; these guides not being on the standards, but placed intermediately, and supported by the horizontal struts and diagonal braces. (4) Steel frames of various design by firms in France, England, and Germany; some having secondary diagonal bracing, others with one ring of very heavy horizontal struts. (5) Wire-rope guiding, designed in England. (6) Spiral guiding, constructed by various firms in England and Germany.

Of these various methods, the wire-rope design is the cheapest to construct; but, on account of corrosion, breakage, damage by ice, necessity for constant inspection and repair, and serious consequences of a slight failure, it has met with small favour from engineers of gas companies. Its defects are not serious with small single-lift holders; but the economy of construction for such holders is very little. For multiple-lift holders, the economy and defects increase—the defects predominating.

The spiral-guiding design is economical of material, but involves a considerable increase of expense per pound for fabrication and erection, and requires great accuracy of fitting. For multiple-lift holders, the presence of numerous sliding brackets and rollers introduces an element of danger in case of a breakage or jam, which does not exist to such an extent with rectangular guides. The design of frame mentioned under the third heading, having intermediate guides, is one worked out with great mathematical precision. But certain details are difficult to arrange satisfactorily; and this difficulty increases with the size of the holder. In the nature of the case, the column presents the readiest and most rigid basis for a guiding, having certain inherent stiffness. To ignore this fact is not economical design.

Some designers consider that since radial stiffness is necessarily greater than tangential stiffness, therefore the radial and tangential rollers must not be used together. By the use of liberal tangential guides, the difference may be brought within reasonable limits; and as these structures are not supposed to be loaded to destruction, there is no practical observable difference. When the rollers are at or near the panel points, the radial and tangential guiding is equally efficient.

There is a practical advantage in construction, levelling, &c., by the use of radial rollers. Furthermore, by the use of both radial and tangential rollers on large gasholders the number of points of guiding is increased; reducing the specific loads on pins, rollers, guides, and fastenings. The general elasticity of the holder and frame will also tend to reduce inequalities. The bearing of a tangential roller on the inside or outside of the flange of a channel, on the flange of a Z-bar, or on the side of the head of a railroad rail, is not to be recommended.

The patented frame with stiff diagonals and no horizontals presents a pleasing appearance, and undoubtedly is a stiff and rigid design. However, a long strut, inclined, may be allowed only (say) 3000 lbs. strain in compression; while a tension bar may be allowed from 12,000 to 16,000 lbs. tension. Two tension bars will then weigh only about half of one compression member, to say nothing of their more simple connections and lower cost of fabrication—being a single rolled section.

The general design presented by the author has been developed as being economical in material and fabrication and erection, giving satisfactory economical results at least expense.

In conclusion, it may well be said that a guide-frame, when carefully designed according to the most approved practice, and constructed of suitable open-hearth steel, is to be classed among the safest examples of modern structural steelwork.

THE DISTRIBUTION OF GAS: PROBLEMS AND SOLUTIONS.

By James Hewett, Distributing Engineer to the City of Birmingham Gas Department.

[A Paper read before the Midland Junior Gas Association, Jan. 27.]

The problem of improving the distributory system arises at one time or another in every gas undertaking—it may be to obtain higher or more equal pressures, or to provide for an increasing consumption of gas, or for other reasons. It is impossible in a single paper to deal with such problems in a general sense; and I propose to confine my remarks to two somewhat dissimilar examples which have recently arisen in connection with the gas undertaking of the City of Birmingham. Local conditions have an important bearing upon the matter; and what may be advisable in one case may be quite unsuitable in another. To make the paper of practical value, it is therefore essential to outline the conditions prevailing in Birmingham.

The Conditions in Birmingham.

The area of supply of the city of Birmingham comprises about 120 square miles, and is in two portions. The larger portion includes the city of Birmingham, the borough of Sutton Coldfield, and parts of several urban and rural districts. It extends nearly 19 miles from north to south, and about 10 miles from east to west. The smaller portion consists of the borough of Wednesbury and the urban district of Darlaston. The former comprises a series of valleys converging to a point situate a short distance due east of the centre of the eastern boundary; the surface water from practically the whole of the area draining towards, and ultimately flowing past, this point. The altitude varies from 250 feet above Ordnance Datum near the centre of the eastern boundary to upwards of 800 feet above Ordnance Datum at several places near the western boundary. Despite such a great difference of level, the change is almost invariably gradual; and there are no precipitous places such as exist in many towns, particularly on the coast line. The main highways lead towards the centre of the area; and, passing from valley to valley, many are, as might be expected, very undulatory. It is largely due to this condition that district governors are little used in the area. Several fixed years ago have, with one exception, been discarded,

The gas-works are five in number—Adderley Street, Nechells, Saltley, and Windsor Street, situated near the centre of the larger portion, and Swan Village between the two portions. The Swan Village works are about 460 feet above Ordnance Datum, and supply the whole of the smaller portion and a part of the larger portion; the other works are between 320 and 360 feet above Ordnance Datum. Upwards of 150,000 private consumers and 24,000 public lamps are supplied through 820 miles of mains, which extend to the boundary of the area of supply in all directions. With a view, as far as possible, to provide an uninterrupted supply of gas to all consumers, the mains are so arranged that, if required, the supply from any one of the gas-works may be partly or wholly taken up by the other works. The output of gas last year was upwards of 8000 million cubic feet, or double that of twenty years ago; and so much as 38,500,000 cubic feet have been sent out in one day.

The variation in the volume of gas issuing from week to week, day to day, and hour to hour is very considerable; and the study of this variance proves, particularly when set out in diagrammatic form, not only instructive, but of interest. It is necessary in this paper to refer in detail only to the hourly output, as approximately representative of the rate of flow of the gas through the distributory system. The maximum hourly output usually occurs between 6 and 7 p.m. upon a midweek day in the winter, and the minimum hourly output between 5 and 6 a.m. upon a Sunday morning in the summer. The hourly output on a Friday and a Sunday in December and June is shown in diagram No. 1. The volumes indicated upon the diagram are "uncorrected"—that is to say, the quantities registered by the station meters during one hour *plus* or *minus* the difference in the stock of gas at the commencement and end of the hour. More often than not the "corrected" volume for the day is greater than the sum of the "uncorrected" hourly outputs—sometimes by 7 per cent.

Wet meters are in general use by consumers; and the pressure of gas upon the district is thereby limited to about 45-10ths. The pressures at the outlets of the station governors are adjusted from time to time, and vary from about 18-10ths during the hours of minimum consumption to about 43-10ths during the hours of maximum consumption. The times and the extent of the adjustments are arranged with a view to maintain the pressures upon the district at all times as high as the circumstances will admit. To this end, pressure registers are maintained in certain parts of the district, and continuous records of the pressures of gas are available from day to day.

Taking Records of Pressure.

Portable registers are also fixed from time to time in other parts of the district, and daily records obtained over short periods—usually one week. In addition, it is essential for the maintenance of an efficient supply of gas to have an intimate knowledge of the conditions prevailing throughout the whole of the distributory system. Provided with this information, when the time arrives for an improvement of the supply to any part of the district it is possible to locate the weakest portions of the system, and effect a remedy in the most satisfactory and economical manner. The mains are dealt with in rotation—two or three each winter; and simultaneous observations are made, during the hours of maximum consumption of gas, at a number of places along the trunk and more important branch mains. For this purpose, provision has been made for the setting-up of a stand-pipe at or near each change in the diameter of the mains and each important junction; also, if these happen to be a considerable distance apart, at intermediate points.

If the gas-main is in the carriage-way, a horizontal pipe is laid so that the stand-pipe may be set up on the footpath, where the observer is not exposed to the risk of being knocked down by vehicular traffic. Men are told off to observe the pressures—one at each selected point. Each man is supplied with a pressure card and a stand-pipe fitted with pressure-gauge and burner. Upon the card is given the exact position at which the stand-pipe is to be set up, and the times at which pressures are to be observed. Figures representing the pressures are filled in the spaces opposite the times, immediately after reading the gauge. An inspector visits each man at least once during the period of observation, and ascertains that the observer's watch is correct and the pressure-gauge in order; also that the figure last recorded upon the card agrees with the gauge. To ensure a reliable average, and to provide against possible errors, this procedure is followed on two or more subsequent occasions—care being taken that no man shall be twice at the same place. The cards are returned to the office, the observer's figures are inked in, and the pressures at the outlet of the station governors are added in another space opposite the various times. In the case of a main several miles long, the cards may be one hundred or more in number; and consideration of the conditions prevailing from end to end of the main is, to say the least, of a wearying nature.

The task is rendered complex by the corrections to be made on account of the altitude of the main at the various points of obser-

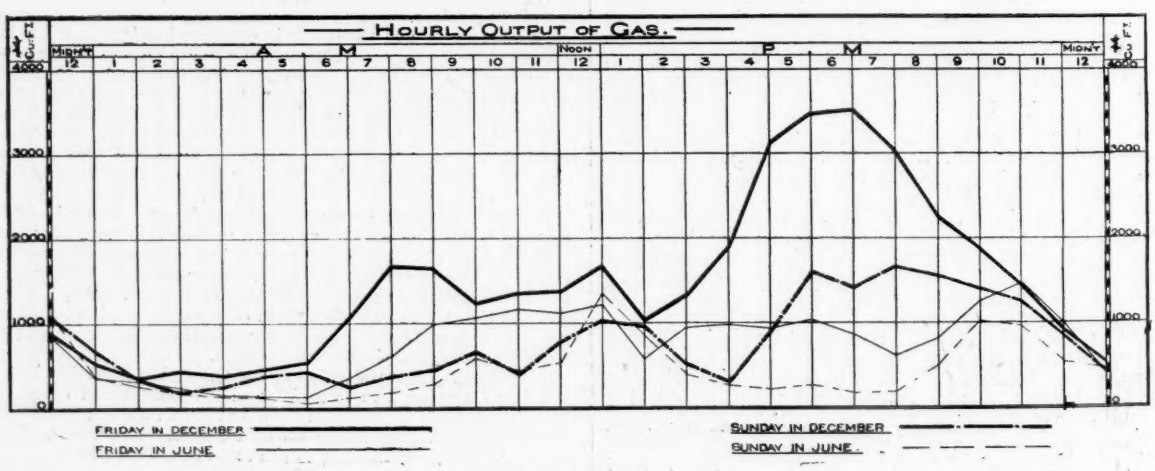


DIAGRAM No. 1.

vation, and in a measure by variations in the distances from point to point. To obtain an intimate knowledge of, and to better realize, the existing conditions, a method has been devised of plotting the mains and pressures in diagrammatic form upon a chart. These charts have been found of the greatest service in the consideration of the means to be provided for an improvement of the supplies, and are permanent records in intelligible and concise form of the conditions prevailing in the mains. Sectional drawing paper with one-inch squares, subdivided into 100 squares, each one-tenth of an inch square, is used for the charts. The distances from the station governor to each point of observation are marked upon a horizontal line to a scale of 500 yards to an inch. Vertical lines are set up from each mark, and upon these the altitude of the respective points of observation is marked above the horizontal line, to a scale of 125 feet to an inch—12 ft. 6 in. to a tenth of an inch.

It is usually stated in books where reference is made to variations of pressure due to altitude, that pressure of gas increases or decreases one-tenth of an inch for every 10 feet rise or fall of the main. The variation, however, depends upon the specific gravity of the gas; and, from a number of observations over a considerable period, the variation in this district ranges from one-tenth in 11 feet to one-tenth in 15 feet. The average is about one tenth of an inch in 12 ft. 6 in.; and the latter figure, being a divisor of 100, and, therefore, suitable for a table, has been accepted for this district.

The table compiled to facilitate corrections for altitude is given. The difference between the figures opposite any two altitudes *plus* or *minus* represents the increase or decrease of pressure respectively.

Correction for Level—One-tenth in 12½ feet.

Altitudes from 200 to 799 feet above Ordnance Datum.

Level above O.D.	200	300	400	500	600	700
0–2	0	8	16	24	32	40
3–5	¼	8¼	16¼	24¼	32¼	40¼
6–8	½	8½	16½	24½	32½	40½
9–12	¾	8¾	16¾	24¾	32¾	40¾
13–15	1	9	17	25	33	41
16–18	1¼	9¼	17¼	25¼	33¼	41¼
19–21	1½	9½	17½	25½	33½	41½
22–24	1¾	9¾	17¾	25¾	33¾	41¾
25–27	2	10	18	26	34	42
28–30	2¼	10¼	18¼	26¼	34¼	42¼
31–33	2½	10½	18½	26½	34½	42½
34–37	2¾	10¾	18¾	26¾	34¾	42¾
38–40	3	11	19	27	35	43
41–43	3¼	11¼	19¼	27¼	35¼	43¼
44–46	3½	11½	19½	27½	35½	43½
47–49	3¾	11¾	19¾	27¾	35¾	43¾
50–52	4	12	20	28	36	44
53–55	4¼	12¼	20¼	28¼	36¼	44¼
56–58	4½	12½	20½	28½	36½	44½
59–62	4¾	12¾	20¾	28¾	36¾	44¾
63–65	5	13	21	29	37	45
66–68	5¼	13¼	21¼	29¼	37¼	45¼
69–71	5½	13½	21½	29½	37½	45½
72–74	5¾	13¾	21¾	29¾	37¾	45¾
75–77	6	14	22	30	38	46
78–80	6¼	14¼	22¼	30¼	38¼	46¼
81–83	6½	14½	22½	30½	38½	46½
84–87	6¾	14¾	22¾	30¾	38¾	46¾
88–90	7	15	23	31	39	47
91–93	7¼	15¼	23¼	31¼	39¼	47¼
94–96	7½	15½	23½	31½	39½	47½
97–99	7¾	15¾	23¾	31¾	39¾	47¾

Tenths of an inch of water column.

The distance from point to point and the altitude of each point is usually acquired from the Ordnance maps. A firm line drawn from mark to mark, and afterwards thickened, upon the top side only, proportionately to the diameter of the pipes, represents the gas-main. The pressure recorded at each point of observation at the time of greatest loss is marked upon the respective vertical lines in a downward direction from the underside of the line representing the main to full scale—that is, one inch for every 10-10ths of pressure. A red full line is drawn through these marks; and a red dotted line is drawn horizontally through the mark representing the pressure at the outlet of the station governor. A blue full line is added, showing the pressure prevailing during the day time; and from the junction of this line and the vertical line representing the station governor a blue dotted line is drawn parallel to the red dotted line. Then at every point of observation the vertical distance from the red dotted line to the red full line represents full size the loss of pressure due to the volume of gas flowing through the main from the station governor to the respective points at the time of maximum consumption. In like manner, the distance between the blue lines represents loss of pressure during the afternoon when the consumption is smaller.

The value of the charts is enhanced by plotting the main correctly, as regards altitude, from end to end, instead of at the points of observation only, and connecting these by straight lines. In such a chart the actual pressures and the losses of pressure at intermediate points may be ascertained, within an inappreciable degree of error, by measuring the distances from the coloured full lines to the underside of the line representing the main and to the coloured dotted lines respectively. The names of the highways in which the mains are laid, the levels of all the points above Ordnance Datum, and the distances from the station governor to each point of observation and from point to point are noted at the top of the charts. The pressures at each point and the loss of pressure from the station governor to each point and from point to point, also the loss in ratio to length of main, are recorded at the bottom of the charts. Every important branch main is set out in like manner upon the same sheet as the trunk main, where feasible, starting immediately above or below the junction of the branch main with the trunk main.

Improvement of the Supply in the Northern Area.

Coming to the first of the two problems—the improvement of the supply of gas in the northern part of the larger portion of the area of supply. In this direction, the district is mainly residential, and the period of maximum demand for gas is from sunset to about 8 p.m. during the winter months. Continued growth in the consumption of gas gradually rendered the existing mains inadequate for the maintenance of satisfactory pressures. At the extreme end of the main, the afternoon pressure of 27-10ths quickly fell as darkness set in to 10-10ths, despite an increase of 23-10ths at the outlet of the station governor at the Nechells Gas-Works. The pressure at the outlet of the station governor was during this period as high as could safely be carried, and, therefore, any improvement by an increase of the initial pressure was out of the question.

Diagram No. 2 shows the portion of the chart relating to the trunk main. It suffices for a consideration of the problem, inasmuch as inadequate pressures and undue losses of pressure prevailed in this portion of the main only. In this instance, the pressures were observed every quarter of an hour from 3 p.m. to 10 p.m., upon three different mid-week days. About 2400 observations were made and recorded upon 81 cards. The maximum loss of pressure was at 6.30 p.m., and the pressures observed at this time were plotted upon the chart, and the line designated "evening pressure." The pressures recorded at 3 p.m. were adopted for the "line of afternoon pressure." In lieu of coloured lines, a heavy dotted black line represents the evening pressure, and a fine dotted black line the afternoon pressure. Fine, full black lines are drawn from the points representing the pressures at the outlet of the station governors at afternoon and evening.

The main is about 10 miles long; and during the hours of maximum consumption, with a pressure of 43-10ths at the outlet of the station governor, the pressure near the end of the main was 10½-10ths. The total loss of pressure due to the flow of gas through the main was 44-10ths, or at the rate of 1-10th in 405 yards. The problem is to reduce this loss of pressure. Such a reduction may be obtained by duplicating or enlarging the whole or a portion of the main; and the extent of the reduction is limited to the sum of the losses occurring in the portion or portions of the main duplicated or enlarged. All other conditions unchanged, the effect of each reduction is to increase the pressure along the remainder of the main in an outward direction to the extent of the reduction.

On the other hand, the main usually diminishes in size from the station governor outwards; consequently, the nearer to the extreme end an improvement is effected the less the cost of obtaining a like reduction of the loss. For instance, the loss of pressure (5-10ths) in the first portion of the 24-inch diameter main may be reduced by about 3¾-10ths, and the pressure along the full length of the main and its branches, outwards, be increased by a like amount by the provision of a duplicate main of equal size and length, at a cost of £2500 or thereabouts; whereas an equal reduction in the loss of pressure may be obtained by laying a duplicate main, consisting of about 900 yards of 6-inch diameter main in Lichfield Road from Bracebridge Road, at a cost of about £300. But the pressures would be improved only from the latter road outwards—a much shorter length of main.

Another factor to be borne in mind is that the higher the rate of loss of pressure the greater the additional loss due to a proportionately increased volume of gas flowing through the main. That is, a 25 per cent. increase in the volume of gas passing through a given length of main will result in an additional loss of 1-10th if the original loss was 2-10ths, or of 3-10ths if it was 6-10ths. In the consideration of this and similar problems, the laws governing the motion of fluids in pipes as embodied in Dr. Pole's formula are used, and the anticipated results are realized within a degree of error covered by known variable factors. The less the variation of pressure in the mains the better; but where considerable variations are unavoidable, as in the case of very long mains, the greatest satisfaction will be given by providing that at every place the highest pressure shall prevail during the lighting hours. Conformably, in this instance, the loss should be reduced by at least 16½-10ths. The chart shows where the loss of pressure is greatest, and it is in one or more of these portions that a reduction may be expected to be most satisfactorily and economically effected.

Consideration was given to four schemes as follows:

1—The laying of a duplicate main, 24 inches diameter, 3300 yards long, commencing at a point 2020 yards from the station governor, at an estimated cost of £7500. The loss of 11-10ths would thereby be reduced by about 8-10ths.

2—Enlargement of 330 yards of 12-inch main to 16 inches diameter and 2990 yards of 6-inch and 5-inch main to 12 inches diameter between the points 10,064 and 13,381 yards respectively from the station governor, at an estimated cost of £2150. The loss of 15¾-10ths would thereby be reduced by about 14-10ths.

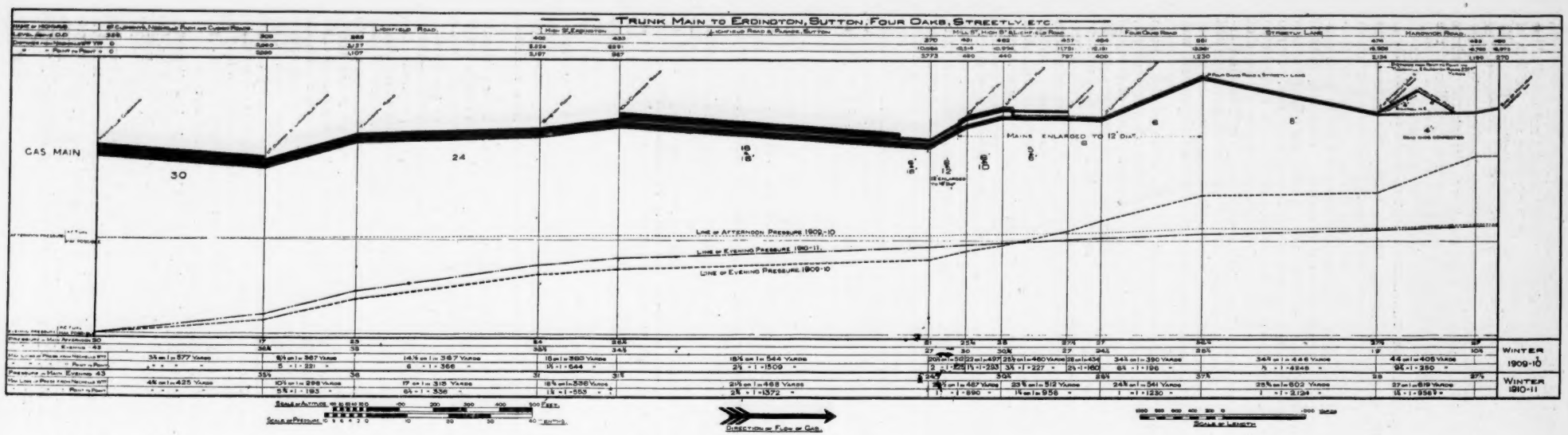


DIAGRAM Nº 2

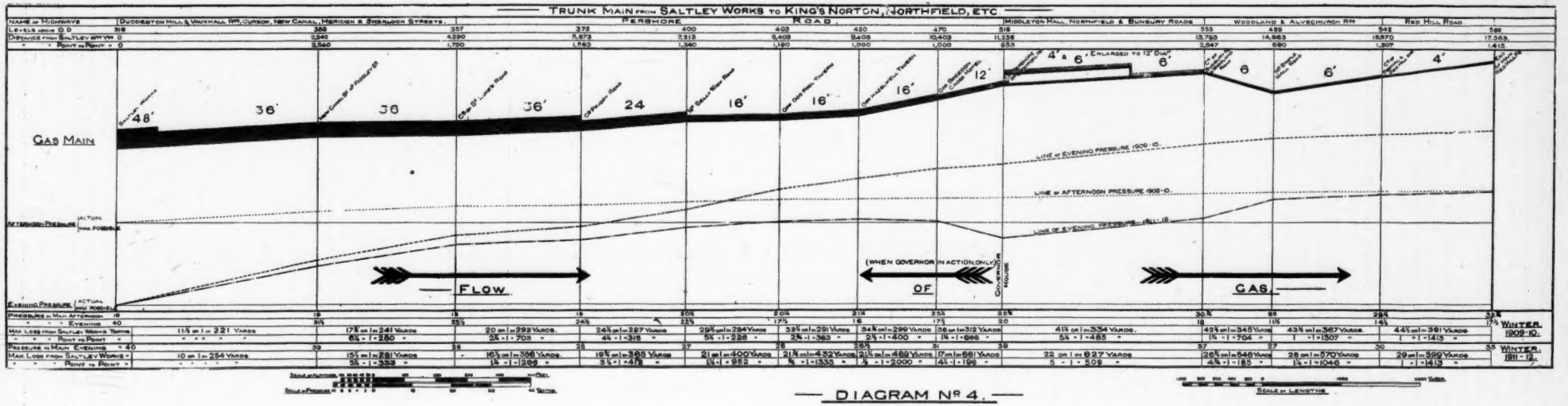


DIAGRAM Nº 4.

3—The enlargement of 580 yards of 4-inch main to 6 inches diameter and the laying of 600 yards of 4-inch main to connect up two dead-ends; thus providing a duplicate feed by a shorter route between a point 15,505 yards from the station governor and the end of the main. This was estimated to cost £280 and to reduce a loss of 9¼-10ths by about 8-10ths.

4—The enlargement of a branch main 2570 yards long to 16 inches diameter and the laying of a new 12-inch main 5900 yards long from the terminal of the branch main to a point near the end of the trunk main, at an estimated cost of £6500. The loss of pressure between the junction of the two mains and the extreme end of the trunk main would thereby be reduced by about 20-10ths.

To meet the growing needs of another portion of the area of supply, a new trunk main has been laid recently; and a branch off this will ultimately reach the junction of the 24-inch and the two 16-inch mains. On this account, any large expenditure upon the initial portion of the main was undesirable, provided the reduction was obtainable elsewhere.

The new main contemplated in Scheme No. 4 was advantageous in that the loop formed with the existing main ensured the maintenance of a supply to the outer district in case of stoppage in it or the existing main. However, no additional consumption was procurable along the route of this main, nor were any developments anticipated there in the near future. The required reduction of loss of pressure was obtainable by adopting Schemes Nos. 2 and 3 with a minimum expenditure; and these were duly carried out.

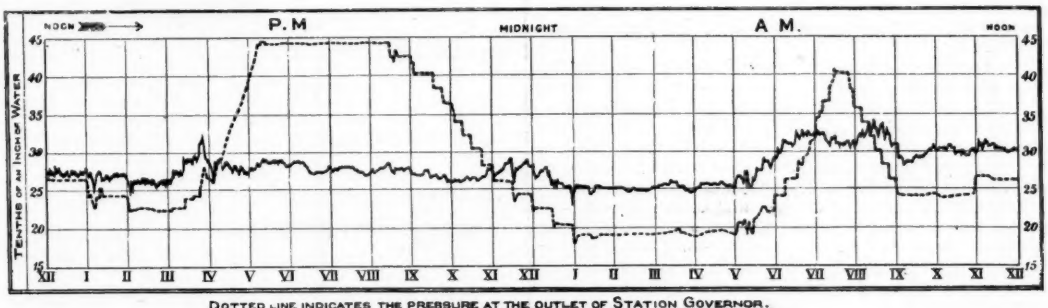
The pressures prevailing during the hours of maximum consumption in the following winter are shown upon Diagram No. 2 by a heavy chain dotted line. It will be noticed that at a point 10,064 yards from the station governor the loss of pressure was 3-10ths more than in the previous year. This additional loss is attributable not only to new supplies, but to the increased consumption that invariably follows the improvement of an inadequate supply. The total loss of pressure from end to end of the main was 27-10ths, as compared with 44-10ths in the previous year. The reduction obtained is, therefore, 17-10ths, or, after making allowance for the additional loss in the initial portion of the main, within 2-10ths of that anticipated.

Upon occasions the necessity of varying the pressure at the outlet of the station governor has been questioned at our meetings, and if on this account only, Diagram No. 3 will be of interest. The variations made at the gas-works are indicated by the dotted line; and the resulting pressure in the main about 5¾ miles distant is shown by the full line. It is possible, under normal conditions, to regulate the initial pressure to meet a variable consumption and at the same time maintain practically even pressures in the heart of a district some distance from the works. But with a range of adjustment at the station governor to the extent shown upon the diagram, it is extremely difficult to adequately provide for abnormal conditions, such as fog, &c.

Improvement of Supply in South-Western Area.

Proceeding to the second problem—the improvement of the supply of gas in the south-western part of the larger portion of the area of supply. The portion of the chart relating to the trunk main supplying this district is reproduced in Diagram No. 4, to which the description of Diagram No. 2 also applies. The main is nearly 10 miles long, and passes through an extensive manufacturing area into a residential district beyond. With the exception of the descent into a valley near the end of the main—in the case of a branch main to the extent of 80 feet—the levels of the main are ideal from a distributive point of view. The period of maximum loss of pressure is from 5 to 6 p.m. on a mid-week day in the winter, when, with 40-10ths at the gas-works, the pressure at one point of the main was as low as 11-10ths. The maximum loss of pressure due to the flow of gas was 44½-10ths, or at the rate of 1-10th in 391 yards, as compared with 8¼-10ths, or at the rate of 1-10th in 2107 yards in the afternoon. The problem is to reduce the loss of pressure during the hours of maximum consumption by at least 15-10ths.

Comparing Diagrams Nos. 2 and 4, it will be seen that the point of intersection of the lines representing the afternoon and evening pressures is over 6½ miles and less than 4½ miles respectively from the gas-works. The position of the point of intersection relatively to the length of the main is an important factor; for to obtain an evening pressure at least equal to the afternoon pressure the capacity of the main must be augmented either before or from this point. In the case under consideration,



— DIAGRAM Nº 3. —

the point of intersection is in the 24-inch diameter portion of the main; and to effect the desired improvement, pipes of at least this diameter have to be enlarged or duplicated. It is, therefore, apparent that the expenditure upon this improvement will be considerably in excess of that incurred in the former case, where the point of intersection was in an 8-inch main. Further, in this instance there is no prospect of the reinforcement of the supply from another direction; and the improvement must also provide for a prospective increase in the gas consumption. The present loss of 44-10ths would be increased by about 19-10ths for a volume 20 per cent. in excess of the present consumption proportionately experienced along the whole length of the main. Adding the reduction to be obtained to make the present supply satisfactory, the total reduction to be ultimately provided is 34-10ths. The improvement may be extended over a number of years; but each portion of main dealt with should be augmented to provide for the contemplated increase of consumption without further expenditure thereon.

To appreciate the magnitude of the task, we will assume that a duplicate main is laid of the same length and diameter, respectively, as the existing main. For the present consumption, the volume of gas passing through each main would be one-half that passing through the existing main. Upon the basis that the loss of pressure varies directly as the squares of the numbers representing the quantities, the loss of pressure would be one-fourth the present loss. Accordingly, the present loss of 44-10ths would be reduced to 11-10ths—a reduction of 33-10ths, or 1-10th less than is required for a volume 20 per cent. more than the present consumption.

Apart from the cost, the proportion of the highways occupied by tramways, foul and surface water sewers, high and low pressure water and gas mains, electric, telephone, and telegraphic cables, &c., places such a duplication practically out of question. The augmentation of a main of this magnitude necessarily involves works of a costly nature; and to this end large sums of money have been expended every five or six years in the past. In view of the great loss of pressure along the first 2 or 3 miles of the main—a condition prevailing in other trunk mains passing through the manufacturing district—consideration was given to the provision of an additional trunk main by an alternative route. The cost of such a main, of a length to introduce an auxiliary feed at a point 3½ miles from the gas-works, would be about £35,000. The augmentation of the weaker portions of the existing main and branch mains from this point outwards, at an estimated cost of £9000, brought the total prospective expenditure to £44,000.

Another scheme was to lay a main from the nearest high-pressure gas-main to the junction of Pershore Road and Middleton Hall Road—about 6½ miles from the gas-works—for the reinforcement of the existing main at this point. An improvement of the gas supply in Stockport, Newport (Mon.), and other towns, has been economically and satisfactorily accomplished upon similar lines. The proposal involved the laying of about 9300 yards of 12-inch diameter main and the provision of a governor and house at an estimated expenditure, inclusive of the cost of a site, of £13,000. For satisfactory distribution from the proposed governor, enlargement of about 2550 yards of 4-inch and 6-inch main to 12 inches was necessary, at an estimated cost of £1400.

An immediate improvement of the supply was anticipated by the introduction, during the hours of maximum consumption, of about 50,000 cubic feet of gas per hour. The existing compressing and boiler plant at the gas-works was capable of dealing with this additional volume; and no expenditure on this account was necessary at the time. The proportions of the proposed high-pressure main and governor provide for the ultimate introduction of about 150,000 cubic feet per hour; and this volume should suffice for the needs of the district for upwards of 25 years. The cost of compressing plant capable of dealing with this volume, and a proportionate cost of the steam plant and buildings, must,

be included to permit of comparison with other proposals. The neighbourhood of the governor is but partly developed; and new mains will be proportioned to pass the increasing volume introduced into the low-pressure system without undue loss of pressure. The estimated additional cost upon this account, inclusive of the enlargement of existing mains radiating from the proposed governor, is £3000; and adding £1500 for the compressing plant, &c., the ultimate cost of the proposal will be about £19,000.

A third scheme was the utilization of another trunk main and the continuation of this to the trunk main in Pershore Road, at a point about 3½ miles from the station governor. Also the provision of a boosting plant at the gas-works, and the installation of six district governors—one each at the point of intersection of the extended trunk main with the existing mains in Pershore Road and five other important highways crossed *en route*. This, as regards arrangement and apparatus employed, is the same as is in vogue for somewhat similar purposes in Edinburgh, North Shields, and other towns. These provisions would reduce the loss of pressure in the trunk main in Pershore Road by 15-10ths, or sufficient to provide for the present consumption only. To meet the prospective growth in the consumption of gas, it would be necessary, from time to time, to augment the capacity of portions of the existing trunk and branch mains from the proposed district governor outwards. To obtain the desired immediate improvement, the flow of gas through the reinforcing main, during the hours of maximum consumption, would be at the rate of about 500,000 cubic feet per hour.

The ultimate cost of the boosting plant, power house, proportion of steam plant, new mains, alteration and enlargement of existing mains, governors, pits, &c., was estimated to be £28,000. This scheme provides for an improvement of the supply over a larger area than the first and second schemes; but this additional advantage may be obtained by carrying out a portion of the scheme, at a cost of about £7000. In the consideration of this problem, profit has been derived from the pioneer work and experience of others; and I wish to acknowledge my indebtedness to Mr. W. R. Herring, formerly Chief Engineer to the Edinburgh and Leith Gas Commissioners, Mr. S. Meunier, Gas Engineer to the Stockport Corporation, Mr. T. Canning, Engineer to the Newport (Mon.) Gas Company, and other gentlemen, not only for the opportunity afforded to view the systems introduced for an improvement of the gas supply in the districts under their jurisdiction, but for much valuable information so willingly and ungrudgingly given.

The yearly charges—taking sinking fund, interest, depreciation, maintenance. and working cost into account—are for the three schemes £2525, £1650, and £2350 respectively. The advantage, both as regards expenditure and yearly charges, lay with the second scheme—the reinforcement of the low-pressure main by an auxiliary high-pressure gas supply. It is also commendable in that its adoption would result in the maintenance of more even pressures upon the district than are obtainable by either of the other schemes. The need for improvement was solely on account of unsatisfactory pressures during lighting hours—varying in number throughout the year, but averaging from four to five per diem. The capacity of the low-pressure mains is ample for the consumption of gas during other hours; and no expenditure will be incurred for compressing gas and attending to the governor other than during the lighting hours.

The scheme was duly carried out; and the pressures prevailing during the hours of maximum consumption of the present winter are shown upon Diagram No. 4 by a heavy chain-dotted line. The total loss of pressure between the gas-works and the extreme end of the main was 29-10ths, as against 44½-10ths two years ago—a reduction of 15½-10ths. The maximum volume of gas introduced into the low-pressure mains was about 60,000 cubic feet in one hour; and at that time the whole of the consumption, outwards, was provided by the auxiliary supply. A considerable loss of pressure is noticeable in the first and second portions of the main outwards from the new governor; and, on investigation, it was found that the flow of gas in a trunk main, 2 miles distant, was reversed. This condition is largely attributable to the low pressures prevailing in the adjoining district, and will be considerably ameliorated should a similar governor be installed there. Gas was also flowing for a distance of about a mile in the direction of the gas-works; and the relief afforded in the portion of the trunk main between the gas-works and the new governor is apparent upon reference to Diagram No. 4. The enlargement of a short length of 12-inch main near the site of the new governor will augment the volume of gas flowing in that direction, and provide additional relief for the initial portion of the trunk main.

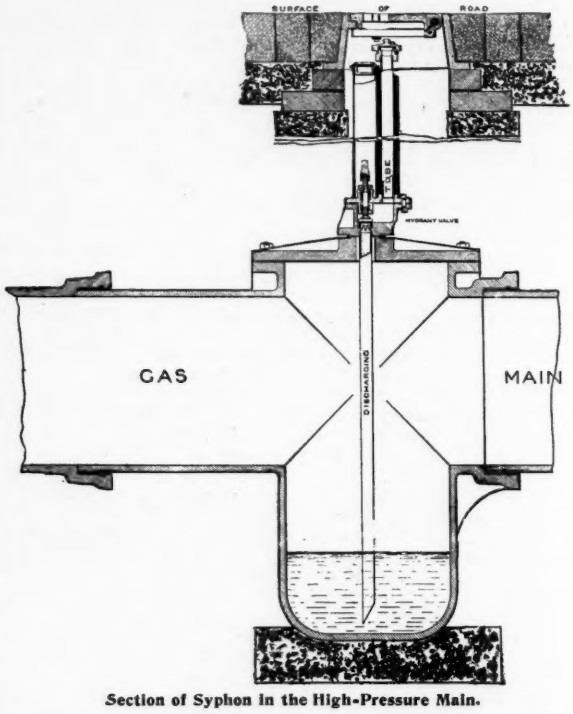
The improvement brought about by the installation is quite up to expectation, and fully justifies the expenditure.

Not only is the maintenance of any desired pressure in the vicinity of the governor assured, but with a moderate outlay upon the enlargement of existing mains or the provision of new mains the variation of pressure at any point within a radius of 1½ to 2 miles may be limited to (say) 5-10ths. The present installation is but a part of a comprehensive scheme for an improvement of the gas supply throughout the whole of the district. The proposition is to instal similar governors 3 to 4 miles apart, each about 2 miles from the boundary of the area of supply. In all, seven to eight installations are contemplated; but about one-half of these will suffice to meet the requirements of the next year or so.

The expenditure involved is considerable; but if present consumers are to be retained and new supplies secured, the maintenance of an adequate supply is imperative. Recent developments, particularly as regards lighting, have created a demand for pressure considerably in excess of the minimum usually prescribed by Statute; and, independent of the moral obligation, it is to the welfare of a gas undertaking to provide same. Despite competition, the prospect for town's gas was never more favourable than at the present time; but to reap the full benefit the supply must be maintained to the satisfaction of the consumers.

High-Pressure Main.

I propose to conclude this paper with a few particulars of the high-pressure gas-main and governors by means of which the supply of gas to the south-western portion of the area of supply was improved. The supplementary supply of high-pressure gas was obtained from a 24-inch main at a point nearly a mile from the compressors at the Windsor Street Gas-Works. The new main is 12 inches diameter and about 5¼ miles long. It is of cast iron, with socket and spigot joints made with white yarn and molten lead. The straight pipes are 12 feet long, exclusive of the socket, and weigh not less than 8 cwt. 3 qr. 14 lbs. each, or about 19 per cent. heavier than pipes of equal diameter used in the low-pressure distributory system. A strip 3⅛ inches wide, extending from the back of the socket to within 9 inches of the spigot end, provides additional thickness of metal for service connections and means of identification. The outside of all pipes and irregulars, excepting 6 inches of the spigot ends and the face of the sockets, is coated with Dr. Angus Smith's solution.



Section of Syphon in the High-Pressure Main.

The laying of the main was commenced about half way between the existing high-pressure gas-main and the site of the proposed governor-house. Two gangs working in opposite directions laid upon an average 29 pipes per diem, exclusive of irregulars, &c. The main is laid with a minimum cover of 2 ft. 6 in., and, where circumstances permitted, under the footpaths. Syphons, of the through pattern, are fixed at the lowest points. These are of cas iron, cylindrical in shape, with solid bottoms and flanged tops, as shown Sockets or spigot ends are cast upon opposite sides of each syphon for connection to the main; and the top is covered by a blank flange.

A hydrant valve is provided upon the cover, and a tube attached to the underside of the valve reaches to within an inch of the bottom of the syphon. The top of the tube attached to the outlet of the valve is a few inches below the surface of the highway, and is provided with a "hydrant" half-coupling and cap. The usual box, with cast-steel door fitted with safety lock, is fixed above the hydrant valve. Pipes are arranged for access to the spindle of the hydrant valve, and for the protection of the discharging tube. The syphon carts are provided with a short length of flexible hose fitted at one end with a hydrant half-coupling. To empty the syphons, the flexible hose is connected in lieu of the hydrant cap, and the other end placed in the syphon cart. The hydrant valve is opened, and the contents of the syphon are discharged by the pressure of gas in the main. After closing the hydrant valve and detaching the flexible hose, any liquid that remains in the tube above the valve is pumped out before the cap is replaced. Isolation valves of full bore, with two parallel discs, are provided in the main about half-a-mile apart. These are double flanged with connectors to suit the cast-iron pipes.

At the foundry, all pipes and irregulars were subjected to a hydraulic pressure of 200 lbs. to the square inch in the presence of the department's ironwork inspector, and to a close examination for flaws and other defects. In addition, test bars from each cast were subjected to tensile and bending tests. The usual method of applying the hydraulic test was followed; but subsequent events prove that this is not entirely satisfactory. The straight pipes are placed between two face-plates; a joint ring is introduced at each end; and the plates are forced against the ends of the pipe by means of a hydraulic ram. Water from a low-pressure supply is introduced through one face-plate; and the air is allowed to escape through the other plate. The filling completed, the water inlet and air outlet are closed, and a supply from an accumulator is admitted until the specified pressure is obtained.

Steam driven air-compressing plant was installed upon a site near the point where the main-laying operations commenced. As pipes were laid and jointed, before the trench was refilled, the main was charged with air to a pressure of 30 lbs. per square inch. Specially-designed plugs, with rubber seatings and clips for attachment to the sockets of the pipes, were provided for capping up the free ends of the main. The provision of these plugs resulted in a considerable saving of time; the work of fixing and removal occupying a few minutes only. After a test, the discharge of air was expedited by gradually slackening the screw provided to force the plug against the inside face of the socket. Tests were made daily, and soap suds were employed to ascertain that all was perfectly sound. As a result, a few pipes and irregulars were found to be leaking through the face of the sockets, notwithstanding all had satisfactorily withstood a hydraulic pressure of 200 lbs. to the square inch. Owing to the manner of closing the ends of the pipes, these defects were not observable under the hydraulic test at the foundry—leakage from the face of the socket being effectually prevented by the joint ring.

Governing Apparatus.

The governors are of the Reynolds patent diaphragm type, specially designed and made by the Bryan Donkin Company, Limited, of Chesterfield, to meet the requirements of this particular scheme. A good idea of the capabilities of the governors may be obtained by the recapitulation of some of the stringent conditions relating to the supply of the apparatus, as follows: The governing apparatus to be in duplicate (only one set to be in action at a time, the other remaining as a stand-by), each set to consist of two governors arranged in series to reduce the pressure in two stages. The pressure at the inlet of the apparatus may vary, at times suddenly, from 1 lb. to 15 lbs. to the square inch. The maximum volume of gas, measured at a pressure equal to a column of water 4 inches high, to be passed per hour is 150,000 cubic feet; but the rate of flow will be subject to considerable and sudden fluctuations. The secondary governor to be capable of maintaining upon its outlet any pressure between 2½ and 5 inches of water-column in steps of 1-10th of an inch; the pressure at the outlet of the primary governor to be 5-10ths above that upon the outlet of the secondary governor. The set pressures to be maintained evenly and constantly without variation, notwithstanding that the pressure at the inlet of the apparatus and the rate of flow of gas may vary as aforementioned. A device to be provided whereby the secondary governor is automatically closed in the eventuality of a failure of the primary governor.

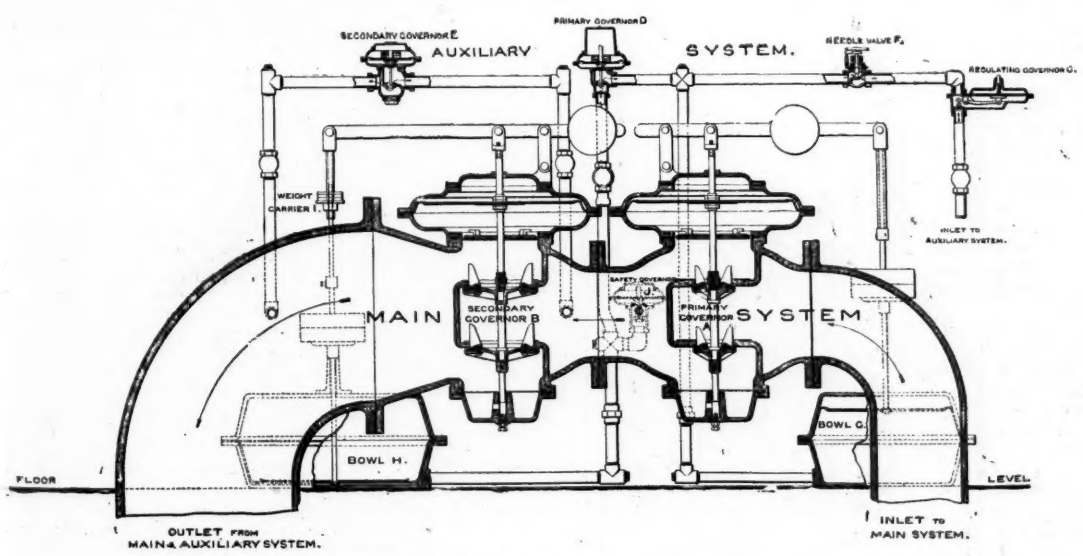
So far as it has been possible to reproduce the specified conditions, the apparatus satisfactorily complies with these requirements. The demand for gas has not approached the stipulated maximum capacity of the apparatus; and in this respect its capabilities have yet to be proved. A description and two illustrations of the governors appear in the "Transactions" of the last session of our Association;* but a short explanation of the action of the apparatus may be of interest. In the section given through one set of apparatus, the inlet and outlet valves fixed below the floor, but actuated from above, are not shown. Each set of apparatus comprises two systems of governors. The main system consists of a primary governor A and a secondary governor B, and the auxiliary system of a regulating governor C, primary governor D, and secondary governor E.

Gas flows through the main system only when the volume to be passed exceeds the capacity of the auxiliary system. The latter deals with the small quantity passing at the times of putting the apparatus in and out of action. The pressure at the outlet of the regulating governor C is varied by turning a set-screw acting upon a spring underneath. The other governors are adjusted by the addition or removal of lead or cast-iron weights. The passage-way between the regulating governor C and the primary governor D is considerably restricted at one part by the needle valve F. This valve is capable of regulation; but no adjustment is necessary once the most suitable position has been ascertained. At the present time, the regulating governor C is set to give an outlet pressure of 20 inches of water-column, or four to five times the maximum pressure required at the outlet of the primary governors A and D. When gas is not flowing through the apparatus, this pressure acts upon the diaphragm in the bowl G, and is so communicated, by connecting rods and lever, to the valves of the primary governor A. The resultant force, supplemented by the outlet pressure acting upon the diaphragm of the primary governor A, presses the valves against the seatings—thus ensuring absolute tightness. Owing to the restricted passage-way, the pressure at the outlet of the needle valve F, and consequently in the bowl G, reduces as the volume of gas flowing through the auxiliary system increases.

By the time the ultimate capacity of the auxiliary system is reached, the pressure in the bowl G is reduced to about 6 inches, and the primary governor A is brought into a state of equilibrium. Then, as the demand for gas increases, the primary governor A automatically opens and deals with the additional volume. Conversely, as the consumption falls off, the primary governor A closes when the auxiliary system is capable of dealing with the volume passing through the apparatus. The pressure in the bowl G (at this period about 6 inches) gradually builds-up as the consumption falls off and the flow of gas ceases, to 20 inches. The primary governors A and D are weighted to give the required outlet pressure; and the slightest building-up of the pressure reduces the volume of gas flowing through the auxiliary system. As a result, the pressure in the bowl G is increased, and, acting upon the diaphragm, assists in reducing the amount of opening in the primary governor A. In the case of a falling off in the outlet pressure, the conditions are reversed. It will, therefore, be evident that the secondary system not only serves to supply the gas required when the consumption is small, but, by means of the bowl G, it enables additional force to be exerted in varying the position of the valves of the primary governor A to meet fluctuations in the consumption.

The secondary governors B and E are solely dependent upon the pressure acting on their diaphragm, and control the pressure upon the district. The outlet pressure is adjusted, as required, by varying the weights upon these governors—a simple operation. The diaphragm of the bowl H is weighted to withstand pressures up to 6 inches of water-column. Should the pressure at the outlet of the primary governor A build-up and overcome this resistance, the diaphragm ascends. The collar upon the connecting rod comes into contact with the underside of the weight-carrier I,

* See "Journal" for May 16, 1911, pp. 449-50.



A Section of the Governing Apparatus a King's Norton.

and the force is communicated, by means of the lever and rod, to the valves of the secondary governor B. The latter is thereby tightly closed, and prevents abnormal pressure getting upon the district. The communication pipe is fitted with a safety governor J, set for an outlet pressure of 10 inches, thereby preventing any excessive pressure acting upon, and bursting, the diaphragm of the secondary governor B.

In addition to the inlet and outlet valves of the governors, valves are provided in the high and low pressure mains, outside the building, for use in cases of emergency. Pressure-gauges are arranged to show the conditions prevailing in the various parts of the apparatus, and pressure registers provide continuous records of the pressures at the outlets of the primary and secondary governors. The certainty of action and perfect regulation of pressure brought about by the auxiliary system will be appreciated by an examination of our records. Breaking-down a pressure of 12 lbs. per square inch to 45-10ths of water-column, pressure is more evenly maintained at the outlet of the primary governors than at the outlet of the secondary governors, which reduce the latter pressure to 36-10ths of water-column.

Governor-House.

The governor-house, excepting the door and frame, is of fire-proof construction throughout. This also is illustrated in our "Transactions." The building is octagonal in shape, and consists of a ground floor to house the governing apparatus, and a cellar for the connections, valves, &c. The walls are built of brindle bricks with best red facing bricks for the external surfaces. The internal surfaces are rendered with adamant cement. A central wall in the cellar supports the governors and carries a portion of the weight of the floor. The latter is of concrete, reinforced with steel. Access to both floors is arranged from the outside. Internally there is no communication between the two floors. The roof, slate covered, is of steel, and consists of eight half principals, purlins, &c., with cast-iron gutters and down-pipes.

Two Sugg's high-pressure incandescent upright gas-burners of 500 candle power each are provided for lighting the ground floor. Each burner is arranged within a cast-iron casing built in the wall of the house. Inside the building, the casing is securely sealed with a dished plate glass window bedded in a pair of gun-metal rings. Outside the building, a sliding door, fitted with a hit-and-miss ventilator for the introduction of air to the burner, provides means of access for cleaning, &c. The products of combustion emerge through a chimney built in the wall of the house. The top of the chimney, fitted with a suitable terminal, is about 18 inches above the slates of the roof. A suitable temperature is maintained in the governor-house by four five-loop "Essex" radiators, connected with the gas-heated boilers in the basement of the recently-erected gas offices and show-rooms adjoining. Four "Tobin" inlet tubes and one Boyle's patent air-pump ventilator, with a 24-inch diameter head, are provided for the ventilation of the house.

Discussion.

Mr. W. E. Cadwallader (Birmingham) remarked that the paper was so complete that it was difficult to find anything to say about it. It would be a revelation to many of them to find, from the details given, how much a distributing engineer had to do. As to Chart No. 3, referring to pressures, he was glad the author had included this; for it showed in a remarkable manner the effect of the station governors on a district some distance away. But there was one thing he would like to suggest—that the pressures during the hours of minimum consumption in the winter should not be dropped quite so much, so that the variations between (say) 10.30 p.m. and 5 or 6 a.m. would not be so great. At the present time, gas-fires were being used more than ever before. In many houses—especially where there was illness—the gas-fire was on all night; but with a view to economy, it was turned down, very often to about one-third of the ordinary rate of consumption. Now, if a house situated within (say) a mile of the works had a gas-fire, and it was turned down to this extent, with a pressure of about 28-10ths at 10.30 p.m., at 2 or 3 o'clock in the morning the pressure would drop to perhaps 15-10ths; and such a drop as this, he thought, would very possibly, with some types of gas-fires, cause lighting-back. If this should happen, it would be, at any rate, extremely disagreeable. Therefore it would be well if the pressure were not dropped to quite such an extent. He did not think it would make any difference to the district farther out. He had been very much interested in the syphon on the high-pressure main. Did the men waste much gas when they were emptying this? He assumed that they just opened the valve, and that the pressure of the gas blew the liquid out of the tube into the cart; but he imagined they had to wait until the gas flowed. He noticed that the bottom of the discharging tube was bevelled, and took it that this was so that they should only get just a little gas as soon as the liquid was out. He would also like to know the effect of compression on the gas with regard to condensation. Hole in his "Distribution of Gas" mentioned this question, and gave his experience as being that the condensation was not nearly so great beyond 200 or 300 yards from the compressing plant as it was at low pressure. Did the author find as much condensation in the syphons on the high-pressure main as in a low-pressure main with a similar amount of gas, and did he find that, after reduction to normal pressures at the governor-house, the compression and subsequent reduction of pressure affected the condensation? If, as Hole said, the gas was dehydrated by compression, did the reduction of pressure at King's Norton cause the gas to absorb much of the water in the wet meters, and was it necessary to water the meters any more frequently because of this?

Mr. C. M'Pherson (Nechells) asked the author if he could give an explanation of the fact that some years ago, before high-pressure gas came to be taken up, many gas managers in the country started putting up supply holders in outlying districts, and fed these supply holders during the low-consumption hours of the day. These holders had to be counterbalanced, so that they could be filled at a low pressure; and when the counterbalance was released and the holder pressure came on the district, they kept up a supply for the outlying areas from the works. He did not know why these relief holders were not more popular. There was no doubt they would have to consider, in connection with high-pressure distribution, the use of small governors in houses, factories, and so on; and it seemed to him that a difficulty was that many of the governors did not really govern the gas down properly, as they claimed to do. He understood the governors at King's Norton were efficient in this respect. The valves were made absolutely tight by leather seatings or some material of this description; but with very small governors—say, the mercury governor—which had metal seats, the difficulty of breaking from high to low pressure was very great.

Mr. C. M. Walter (Birmingham) said he had been asked by Mr. E. W. Smith to apologize for his absence from the meeting. The charts accompanying the paper gave many details in a concise form; and they saw the pressure-drop at every point. With reference to bends, however, Mr. Hewett had not given them any particulars. Then, did he find Dr. Pole's formula agree for tests carried out on the high-pressure main? He himself found by tests that it agreed very well for low pressures; but dealing with gas at about 10 lbs. per square inch, it seemed to be much out. As to high-pressure gas supply from dead-end mains. Supposing a firm took a considerable supply from a dead-end main, would there be any effect due to the inertia of the moving volume of gas when the supply was suddenly cut off? In the case of hydraulic supply, this was very important; and he would like to know how it would affect them in high-pressure gas supply. With regard to keeping gas at a constant pressure in the centre of the town, apparently when they had the demand on the high-pressure mains increasing, it would be necessary at the compressor-station to increase the pressure considerably to maintain this constant pressure. Had Mr. Hewett carried out any experiments in this direction with the Pitot tube, which should be valuable to ascertain the output of gas from the compressor-house? He thought himself that the use of this gauge, in conjunction with the static pressure-gauge, would be invaluable for adjusting the pressure at the works, so as to keep the pressure constant in the centre of the city.

Mr. R. S. Ramsden (Burton-on-Trent) said that the figures quoted showed a ratio of about 1-200th of the annual output as the maximum day's output. This seemed to follow on general lines; and the maximum hourly output of about 1-10th of the maximum daily output—or about 1-2000th of the annual output—agreed fairly well with what they had experienced at Burton. The question had arisen in connection with the supplying of outside districts; and he would like to know whether these figures could be safely relied upon. As to the details of mainlaying work, he understood Mr. Hewett put valves in about every half-mile. This seemed much closer than was generally adopted with a low-pressure main; and it would be interesting to know the reason for having so many. In connection with the air-compressing plant for testing the mains as laid, did Mr. Hewett know of any handy portable power plant, as distinct from the steam operated one to which he referred; and had he any method of overcoming the difficulty in connection with testing pipes at the foundry which he had described?

Mr. W. Batt (Birmingham) asked why preference was given to cast-iron mains over steel.

Dr. W. B. Davidson remarked that the author had thought it better to deal with a few of the problems, than to give them a general paper on distribution—the number of problems involved in which was amazing. Mr. Hewett had dealt with his subject in a very lucid and simple manner; and he was to be congratulated on the success of his diagrams in showing the main points of the conditions of pressure, and so on. It was an ingenious method of plotting loss of pressure, &c. He quite agreed with Mr. Cadwallader in what he said about the pressure at the works being reduced to as low as 18-10ths or so. He thought if he had a gas-fire within a short distance of the works, he should not expect to get such good results as if he were some distance away at a higher altitude. There was no doubt in his mind that the ideal system of distributing was to use high pressure on the works—as high as they could (say) up to 7 or 8 inches—and govern-down for each consumer. This was done, he believed, in many parts of London; but whether or not it was a profitable business, was another question. They were all aware of the difficulties and the troubles with governors, and also of their cost. It was a matter of policy, which was the better way; but certainly the consumer stood to get more satisfaction by having his gas always coming at a definite pressure, than if he was liable to have the pressures varying night and day in the manner mentioned.

Mr. F. J. Ward (Knowle) pointed out that the author said the district of supply ran up to an altitude of about 800 feet, and that he found the pressures must be limited to 45-10ths. What were

the pressures at 800 feet? Did he find any difference, or much difference, in the pressures, when the specific gravity of the gas varied through the sending out of a greater or less amount of water gas? Coming to the question of how Mr. Hewett had overcome his difficulties in the way of increasing the supplies on the trunk mains, he must express his astonishment that the City of Birmingham had allowed such a state of things to exist as was found by the author—pressures down to about 11-10ths, and that sort of thing. The schemes in both the northern and south-western areas had got over the trouble very well; but one could only wonder why, in the latter case, the trunk main put down started at 48 inches, then came down to 36 inches, and suddenly dropped within a few yards to 16 inches. He would hardly consider this good work. They could understand loss of pressures to a certain extent there. The author said that, "upon occasions the necessity of varying the pressure at the outlet of the station governor has been questioned at our meetings." Well, he pleaded guilty to calling in question the necessity of altering pressures. He had said that he did not do it at Knowle; and it would not be necessary in Birmingham to do it, if mains were sufficiently large. The mains had not been increased in size at the same rate as the consumption. The diagram showing the pressures about 5¾ miles from the works, proved that the consumers there and farther out had a very comfortable time; but what did the people just outside the works get? They got 18-10ths, and they got 45-10ths. He did not think that this was right. There were, as had been mentioned, gas-fires and gas-engines going; and it was as necessary to have a full pressure at night as it was during periods of maximum consumption—within, of course, a few tenths. Had the author considered the question of laying steel mains instead of cast-iron ones; and, if so, why did he not select them? He himself last summer carried out a rather extensive increase in mileage, and had gone in entirely for steel mains. He had one or two interviews with managers who had done the same thing, and they all agreed with this course. In every respect (except one, which time alone could prove), he advocated steel mains as against cast-iron ones.

The PRESIDENT (Mr. R. J. Rogers, of Birmingham) proposed a hearty vote of thanks to Mr. Hewett for his excellent paper—remarking that he had given the Association information that would not only be useful to their own members, but would be studied by distributing engineers throughout the country. The author had very wisely prefaced his description of the system adopted by a statement of the condition of affairs that prevailed in Birmingham at the time. He had noticed in connection with some of the papers written from time to time on distribution schemes, that the authors did not give sufficient indication of the prevailing conditions; and therefore it was very difficult to come to a conclusion as to whether the particular system they might be working would be likely to answer in the case of the problem they had to solve themselves. One point he noticed in the paper was with regard to the additional loss of pressure on the new line of main which was noticed after it had been put down. At first sight this was rather striking; but the author explained that it always followed on the improvement of an inadequate supply. He himself had noticed this on many occasions; and it only emphasized the necessity for giving this improved pressure and volume. If the consumer could not get sufficient gas, naturally he did not use it. It was the right thing to give plenty of gas; and if this were done, the consumers would recognize it by taking more. The question of day and night pressures was a very important and a very complex one. Dr. Davidson had referred to the system of governing separately at consumers' houses. This might be the ideal plan; but it would cost an enormous amount of money. It seemed to him the question of governing would not be altogether settled until they got a governor that was satisfactory from the point of view of the consumer having it in his house. He did not think from what he had heard of them that governors were now all they might be for this purpose. Many undertakings, he knew, had adopted them largely; but he did not believe they had reached such a state of perfection that it was possible to recommend them, as one might say, wholesale. The problems that were being raised now in large cities on account of improved methods of locomotion would no doubt be brought before distributing engineers in the near future more than had been the case in the past. On the fringe of the outer border of big towns a demand was arising for garden cities and residential suburbs; and so the question of a proper gas supply had to be considered. It was in such cases that the information Mr. Hewett had given them would be found particularly useful.

Mr. W. H. JOHNS (Saltley), in seconding the vote, said a good deal of the discussion had centred round the planning out of the pressures upon the charts. He quite agreed that this was an excellent and easy system of keeping before one the varying pressures throughout the district. Of course, in large undertakings there was no difficulty about adopting it; but with members who were associated with smaller concerns, such work could not be carried out. He meant by this that the usual practice on the smaller works was to take the pressure of the leading mains in various districts during times of maximum consumption. The pressures then were recorded in a book kept at the works, and compared with pressures taken in the corresponding week of the previous year. A big drop in pressure was a sign that the main in the particular district was becoming overtaxed. Of course, Mr. Hewett had gone into the matter very thoroughly. On a small works this was impossible; and in such cases no difference was allowed for the various altitudes of the different districts. He quite believed in supplying a good pressure throughout the twenty-four hours; but some of the speakers seemed to have forgotten that there were such things as duplex taps, so that it was not necessary to turn down a gas-fire—which was a very bad practice. If an up-to-date gas-fire with a duplex tap was put in, they could shut off three or four burners at each side, and still have the other burners on full, quite independent of any pressure changes. Mr. M'Pherson had referred to the question of putting up holders in outlying districts and filling them during the periods of minimum consumption. It was an expensive matter to erect these holders and tanks on the outskirts; and it was much more economical to feed the districts which required extra pressure by means of compressing plant at the gas-works, and through high-pressure mains—preferably, in his own opinion, Mannesmann tubes, which were cheaper to lay. He would like Mr. Hewett to give the comparative costs of the laying of Mannesmann tubes of similar sizes to the pipes which he had adopted, and to tell them why the joints were not made with lead wool, instead of molten lead. Had he made any tests of lead and lead wool for the purpose?

Mr. HEWETT acknowledged the vote, and expressed his indebtedness to Mr. Bottwood and Mr. Liney for the assistance they had rendered in the preparation of the paper. In the course of his reply to the discussion, he said that Mr. Cadwallader had dealt with Chart No. 3 with regard to low pressures after midnight. He thought he had made it clear that the point he was aiming at was to get as high a pressure as possible during the twenty-four hours; but owing to the great variations in the altitude, and the consequent increase in pressure, at different parts, there was a certain amount of restriction in the compressing system. It must be remembered that they had mains upwards of 12 miles long. Take midnight first. At the gas-works they had a pressure of 19-10ths; and 5¾ miles away it was 25-10ths. It was impossible to increase the pressure at the works during this period, because they had other parts of the district 700 feet above the sea. This particular point was 390 feet. At the present time the pressure in the higher part—that was, beyond 5¾ miles—was 45-10ths after midnight; and any increase at the works would add to this pressure. Owing to the presence of the wet meters which they had now, and the smaller sizes of which would blow at about 45-10ths, they could not put up the pressure any higher. He might mention that they had made an arrangement with regard to the blowing of the meters. That was, they had the pressure increased about 1-10th every month, and had a certain number of the meters blown. These meters were sent in to the works, and an adjustment was made by the provision of a gland, by which they were enabled to stand anything up to 7 inches. So that in time they would be able to increase the pressures correspondingly. As to getting even pressure, the idea was to have these governors so that they could balance it. If they had long mains, and there was a big volume of gas, they could not get the same pressure at the end as if there was no volume at all passing. If they were passing gas through the main, there must be a loss of pressure; and the larger the quantity, the greater was the loss of pressure. The idea was to reduce the length of the mains by putting governors at intermediate points. He agreed that the pressure should be as high after midnight as in the day; but the difficulty was to get it under present conditions. As to the waste of gas in the high-pressure syphon. They could hear when the gas was coming; and the man at once turned off the valve, which was a very simple one. There were two men employed, one of whom stood by the valve. A little gas was wasted, but no appreciable amount. The tube was bevelled so as to reduce to a minimum the quantity passing out. With regard to the effect of compression on the gas. Of course, at the works it was the same in high-pressure distribution as in low—they got a great quantity of condensation in the neighbourhood of the works. Even with low pressure, he did not suppose they had 1 per cent. of condensation outside a radius of about 2 or 3 miles of the works. If syphons were making water outside an area of 2 miles, it could be taken for granted that there was a leakage somewhere. In the case of King's Norton, which was 6¾ miles from the works, it was impossible for him to say whether the gas after expanding would pick up moisture or not, because they had not the moisture in the mains. He could give no information as to the effect on the meters. Mr. M'Pherson had spoken of district holders. Of course, the district holder after all was nothing more or less than these installations. If they had a district holder, by all means let them utilize it; but if they had none, they would have to go to Parliament to obtain permission to put such a holder up. Then, again, the outlying districts as a rule were residential areas, and the opposition would be very great to the placing of large holders there; whereas a governor-house was small, and not unsightly—as a matter of fact, it could be made to agree with the architecture of the neighbourhood. Had he a gasholder in any part, he should certainly use it, because he could compress the gas and send it on to the holder, or suck the gas through the low-pressure mains by means of machinery at the gasholder site. These installations were to provide a similar effect to the gasholder. He had not yet found a satisfactory small consumer's governor. Provided they were working, they were more or less satisfactory; but their great failing was that if there was no consumption they would not hold the pressure back. The King's Norton governors would do this. Mr. Walter asked whether he had any information as to the flow of gas through bends. He had not, because he simply had to deal with things as they were. There would not be any reason

for him to get information from any particular point. The mains were there; and a certain quantity of gas was flowing through them. All he wanted to know was the actual loss on these particular mains. A good many people had been going into this matter; and their results varied. As to Dr. Pole's formula, with high-pressure gas he did not think it would be satisfactory, because they did not get any correction for the absolute pressure. In the case of low pressures, it practically made no difference; but when they were going up to 15 or 30 lbs., they must correct for this. He thought it was only correct for pressures of about the pressure of the atmosphere. As to the query about the Pitot tube, he took it the object was to ascertain the volume of gas passing from the works at any particular time, so that the pressure could be regulated accordingly. They had already means for ascertaining this; and he could see no necessity for the tube. If it were possible to regulate pressures to the volume of gas passing from the works at any particular time, it would simplify matters; but it was not possible. It all depended upon the point of consumption. They must maintain a suitable pressure at every part of the district. The figures given by Mr. Ramsden for the ratios of daily output to yearly and hourly output to daily were about the average. In "Field's Analysis," the maximum daily output varied from 1-180th to about 1-250th of the yearly output. Of course, in low-pressure mains it was exceptional to have valves; but in the case of high-pressure mains there were different considerations. The idea of the high-pressure system was that in time it would be on the circular plan—that was, they would be able to shut off a section and feed from either way. Everything was arranged with the object of connecting right round, so as to permit of separating small sections. Another reason was in regard to testing. The valves did not cost a great deal; and putting them in at these short distances, they never had more than half-a-mile of main to blow up. As to testing, the two steam air-compressing plants used were portable, and were employed about the streets; but the contractors for laying the main (Messrs. Aird Limited) stated that they had ordered a small petrol air-compressor. Of course, the steam plant was not suitable for some streets; but the petrol plant should overcome everybody's objections. They had not got over the difficulties in testing the pipes at the foundry; but they were trying an arrangement which had this object in view. Questions had been asked as to why preference had been given to cast-iron mains over steel tubes. To discuss the relative merits of cast-iron and steel mains would easily occupy them for an afternoon; there was much to be said for them both. Unfortunately cast-iron was liable to fracture. If it were not for this fact, he did not personally think steel mains would be in the running at all. But the question of fracture was most important; and for this reason the gas-mains in Birmingham were made in steel up to and including 6 inches diameter. For 8 inches diameter and above, they were in cast iron, because it was found that pipes laid at a proper level below the ground were practically free from liability to fracture, except from some special cause. Of course, cost was a great consideration, providing the alternative was satisfactory; and the quotation for 12-inch steel tubes was about 25 per cent. more than for cast-iron pipes of the same size. At the time when this installation was first started upon, the idea was to have pressures of from 3 to 5 lbs., which might ultimately go up to 10 lbs.; but the use of high-pressure gas had progressed so rapidly that they had now got to 12 lbs. for industrial purposes, to attain the best efficiencies. Therefore the pressure was raised throughout to meet the requirements. With regard to steel mains, perhaps the greatest objection was on the score of life. It was said that, with a protecting covering, they would last longer than cast-iron mains; and this could not be refuted entirely, though the result of the Coolgardie main rather opened one's eyes. Having covered the pipes, provided the covering lasted so would the pipes; but how long would the covering last? Mr. Ward asked how it was, if they had altitudes of 800 feet, that the meters did not blow. It was these altitudes that were keeping the pressures down at the works; and when the meters were all altered, the pressures would be increased. The specific gravity of the gas, of course, made a great difference. The higher the specific gravity, the greater the loss of pressure. With regard to the change in the diameter of the mains, unfortunately, of course, he could not show the whole system. This was simply the trunk main. At every one of the changes in diameter, there were other mains going off; and there were a lot of mains in between. The size of the main was really proportional to the volume passing through its length.

Mr. G. Ball (Saltley) pointed out that the 16-inch main was the original trunk main laid from the Saltley works to King's Norton, about 1868.

Mr. Hewett (continuing) said he agreed with the President as to the advantage of improving these inadequate supplies. The greater loss was due to the greater consumption; and though the consumers paid more, they got what they required. It was a very rare thing to receive complaints from a district where the pressure had been improved. Mr. Johns mentioned lead wool. Of course, they were quite aware of lead wool; and before starting upon this work, tests were made with this and with ordinary molten lead. They were tested with solvene at 90 lbs. pressure, and the pipes daily vibrated; and both joints remained sound. There was no reason to think one was better than the other. He preferred molten lead because, in case of vibration, it was solid. They might get leakage between the cast iron and the lead; but in the case of lead wool, there would be a tendency for leakage to arise, not only between the lead and the iron, but between the strands of lead. He pointed out, in connection with the statement in the paper that "More often than not the 'corrected' volume for the day is greater than the sum of the 'uncorrected' hourly outputs (sometimes by 7 per cent.)," that in Birmingham the registrations of the station meter are corrected to an average temperature of 60° Fahr., an average barometer pressure of 29·70, and a holder pressure of 3 inches head of water.

SHADES AND REFLECTORS.

The third of the series of lectures now being delivered by Mr. J. S. Dow at the Regent Street Polytechnic was given last Thursday, and dealt with "Shades and Reflectors."

The lecturer recalled that Dr. Ettles, before Christmas, had described the complexities of the eye, the action of the pupil aperture in protecting it from the excess of light, and the manner in which the delicate retinal layers adapted themselves to strong and weak illumination. Now it would be seen that all our impressions regarding lighting were received through the eye. One must, therefore, take into account its structure when interpreting experiences in practical lighting problems. Any sudden contrast in brilliancy, either successive contrast (as illustrated by a flickering light, or the passage from a very dark room to a very bright one) or simultaneous contrast in the form of adjacent extremely bright and dark surfaces, was fatiguing. The reason was that the mechanism of adaptation was called upon to act too suddenly, sometimes even strained by an effort of accommodation too severe to be accomplished.

These effects were generally classed as "glare," and should be avoided in artificial lighting. Apart from the occasional injury to the retina that prolonged exposure to very bright lights might cause, even a slight amount of dazzling might cause inconvenience or danger; and Mr. Dow mentioned as illustrations cases of workmen stumbling on scaffolding through badly placed lights, people failing to recognize each other in the streets, &c. Several photographs were then thrown upon the screen showing that the photographic plate, like the eye, could not adapt itself to great extremes in brightness. One either secured a hopeless flare instead of the bright object or else complete obscurity in the less brilliant regions.

The lecturer proceeded to show how the intrinsic brilliancy of modern sources had continually increased—giving a table to this effect. He also explained the methods of expressing "brightness" in the form of "candle power per square inch," usually called "intrinsic brilliancy," or as foot-candles (surface-brightness). The latter method was usually applied to illuminated surfaces, walls, ceilings, &c.; the former, to actual sources.

He next quoted some rules for the avoidance of glare, based on Professor Weber's recommendations. These rules, he pointed out, could not always be applied rigidly; but for lighting comparatively small interiors, it would be a good thing to adhere to them when possible:

(1) Any source in the field of vision to be toned down to an intrinsic brilliancy of 2·5-candle power per square inch (about the brightness of the average white sky).
(2) Sources of light should make an angle of 60° with the normal direction of vision of people at work in a room (the eyebrow and eye-lashes protect the eye from rays striking it at greater angles than this).
(3) The contrast between the brightness of objects visible to the eye should not exceed 100 : 1.

Mr. Dow then passed on to the uses of shades, globes, and reflectors. It was necessary to distinguish several distinct functions—namely, (1) to obscure sources of undesirable brightness or tone-down their brilliancy, (2) to soften the shadows by diffusing the actual source over a larger area, (3) to modify the polar curves of illuminants, taking the light from directions in which it would dazzle the eye and directing it usefully where it was needed, (4) for purely decorative purposes.

A method of screening lamps which was now becoming very usual was the so-called "indirect" lighting, in which all the light was thrown on a white ceiling or other diffusing surface and then allowed to be scattered over the room. This method had the great advantage of completely concealing the light-source, and furnishing soft shadows. It was commonly used with arc lamps; and high-pressure gas indirect lighting had, he understood, been successfully used in schools in Germany. At present, indirect methods did not appear to have been used very extensively in this country with gas lighting. An objection often raised to indirect lighting was on the ground of "flatness;" but he thought this was the result of injudicious arrangements, or of having the entire scheme of decoration of a room in too light a colour. A well-designed indirect system was not "shadowless," although the shadows were naturally softened.

Mr. Dow then proceeded to show a series of slides of indirect and semi-indirect arc lighting, and a few of the latest examples of indirect lighting with tungsten lamps. He then explained a series of diagrams by Mr. J. Darch, showing how the eye could be screened by arrangements of opaque or semi-transparent shades which only allowed the light to escape in directions in which it could not strike the eyes. The diagrams showed the application of this method to inverted gas-burners, electric glow-lamps, and acetylene flames. Reference was next made to the

admirable selection of shades and reflectors exhibited by the Gaslight and Coke Company, many of them being very dainty and tasteful in appearance. The lecturer pointed out the value of the educational work of the large gas companies in encouraging consumers to use their lights with shades, and providing a wide selection instead of the deficiency prevailing in the past, before they began to exercise their influence in this direction. Some slides showing common types of shades used with gas-burners were next shown—some being criticized and others commended.

The lecturer then passed on to some special forms of reflectors designed mainly to concentrate the light in certain directions. The Huntalite tubular porcelain reflector was shown in operation; and the new picture-lighting reflector of Holophane Limited was also exhibited. There were also two cabinets, fitted up respectively with steel reflectors and with the Holophane prismatic glassware, in which the effect of different forms of reflectors on the downward illumination, and the improvement in this respect compared with a bare lamp, could be exhibited. A measurement taken with the "Holophane" lumeter at one point in the lecture showed that by the use of a certain reflector an improvement from (say) 1 to 15 foot-candles could be secured. It was explained that the advantage in these scientifically designed Holophane prismatic and steel reflectors lay in the fact that the different types available enabled one to select the correct shape of polar curve for any special set of circumstances. Moreover, these curves could always be reproduced exactly, and one could, therefore, predict beforehand what the resultant illumination would be. A word or two was also said about street lighting units; the value of the dioptric globe with the Excello lamp being explained and illustrated. The lecturer also pointed out the vast unexplored field of the use of shades in decorative lighting. As an example of the use of light transmitted through a shade for ornamental effect, he exhibited several forms of "Spookie" coloured shades.

In conclusion, the lecturer showed a few more slides of installations in which various forms of shades and reflectors were employed; one of the most interesting being a photograph of the lighting of the new enclosed tennis courts at Dulwich, lighted by the South Metropolitan Gas Company with Keith high-pressure gas-lamps. He explained the importance of softening the light in such cases by special forms of shades. In this installation, a plate of diffusing glass was placed under each lamp in conjunction with a concentrating silver reflector.

ASSOCIATION OF CONSULTING ENGINEERS.

The Inaugural Meeting of this Association was held on the 15th inst., for the purpose of formally receiving the rules that were drawn up by the Committee appointed for the purpose at the opening meeting, and noticed in the "JOURNAL" for the 2nd inst. (p. 19). Mr. JAMES SWINBURNE occupied the chair, and was supported by the majority of the Committee. The Hon. Secretary (Mr. Alfred H. Dykes) was in attendance.

The CHAIRMAN, in opening the proceedings, explained the objects of the Association, which he said should have been started fifty years ago. In the present state of things, however, it was very difficult to form an Association in such a way as to be satisfactory to everybody. At the same time, he was of opinion that if consulting engineers did not take this opportunity of uniting themselves together, there was no chance of their ever doing so. It behoved them, therefore, to proceed very carefully, and to build on sure foundations. If they began by making the Association very small—perhaps, in the opinion of many, too small—when it was in active existence it could always enlarge itself in any direction desired, should it be thought advisable. One of the qualifications in the rules for membership was that the applicant should be a full member of the institution controlling the branch of engineering in which he practised. But the Committee were of opinion that it would be wise to adopt some recognized standard, and to limit the first members to those possessing the qualification of corporate membership of the Institution of Civil Engineers. This restriction might be criticized by some people, who might say that they were mechanical engineers or electrical engineers, and of eminence in their profession, and did not see why the fact that they had not joined the Institution of Civil Engineers should prevent them from joining the Association. On the other hand, it must not be overlooked that the Institution was not only the oldest, but was the parent engineering institution, and that the majority of consulting engineers already belonged to it in addition to the institutions representing the particular branch in which they practised. If any competent consulting engineer who was not a member of the Civils felt aggrieved that he could not belong to the Association, surely it was not requiring a very great deal of him to ask him to join the Civils. The Association did not aim at stopping competent consulting engineers who might not join them from doing consulting work, nor did they wish to claim a monopoly. The Committee felt, however, that engineers falling within the class he had outlined were entitled to associate themselves together, and form an Association which would gradually, through its own standing and character, become recognized as the body of consulting engineers.

The proposed rules were then discussed. The main points to which speakers referred were the scope of the Association, the desirability or otherwise of the membership being restricted to corporate members of the Institution of Civil Engineers, the registration of consulting engineers, the solicitation of work, and the desirability of consulting engineers being free from trading or manufacturing interests.

At the close of the discussion,

The CHAIRMAN put a motion to the meeting to the effect that corporate membership of the Institution of Civil Engineers should be a condition of membership of the Association (with discretionary power to the Committee); and that the Committee should have power to elect members from among those who have applied.

This motion having been carried, the proceedings terminated with a vote of thanks to the Chairman.

KIRKINTILLOCH GAS-WORKS BOOSTING PLANT.

By JAMES BELL, of Kirkintilloch.

[A Paper read before the Western Section of the Scottish Junior Gas Association, Jan. 27.]

When designing telescopic gasholders, one important, and very essential, point to keep in view is that the dimensions are arranged in such a way that the holder when working on the single lift will be able to maintain the maximum pressure required on the district, with a margin in excess to meet the requirements of the future. Another way is to put heavier material into its construction. If this is not done, then it naturally follows that you impair your workable storage capacity. The latter is the position in which we were placed with the new spiral-guided holder. It was only possible to supply the town satisfactorily when the holder was cupped. Therefore, under such conditions, our stock of gas available for distribution was 270,000 cubic feet, with the holder quite full and containing 500,000 cubic feet; leaving 230,000 cubic feet practically unavailable.

Our daily consumption would jump from 300,000 to 400,000 cubic feet in a day, with the retort power only producing the lesser quantity. It was a difficult matter to cope with such a sudden demand, especially when it lasted for a day or two; and before we could get another oven into action, the deed was done. Once or twice this occurred, but, fortunately, at a late hour in the evening, when it was not much noticed. After this experience, we invariably kept an oven under fire, ready to meet any emergency likely to arise in the shape of increased demand in the district. This was not a desirable state of matters; so I set myself the task of finding the remedy. To get over this difficulty, I carefully considered four methods that might suit the circumstances. The first I thought of was that of adding cast-iron weights, laid on the crown of the holder, at its strongest part—viz., round the top curb; but finding that about forty tons were required, I at once saw the impracticability of such an idea. Being a spiral-guided holder, it would have added considerably to the wear and tear of the guides and pulleys, as well as making it top heavy, thereby affecting its stability. If it had been possible to put the holder out of action for a time, the weights might have been attached to the vertical stiffening bars inside the inner lift. But only having the one holder, this scheme could not be carried out. It would have been possible to work the holders at the old works, directly through the distributing mains; but this would have led us into serious trouble with the consumers, as well as loss from leakage (something like a 7-inch pressure would have been required to fill the holders referred to).

The second method considered was to remove the column-guided double lift gasholder of 90,000 cubic feet capacity from the old works, and re-erect it on a new site at the new gas-works—the tank being of cast iron, and in good condition. My idea was to use this as a distributing holder, and, by means of a small gas-engine driven exhauster, to supply this holder with gas drawn from the spiral holder when that vessel was working on the single lift. The removal and erecting of this holder was to cost nearly as much as the erection of a new spiral-guided holder of similar capacity. This being the case, it was considered an undesirable project, and abandoned.

The third method, to which I next concentrated my attention, was the laying of a high-pressure trunk main from the new works, to supply the holders at the old works; but the cost of carrying this out was going to be heavy, while the bringing into operation of these old holders meant a considerable increase of our oncost charges. It would have been necessary to station a man at the old works to take in gas to the holders. It would also have necessitated the use of station governors at this point, which meant late and early hours for the man in charge, putting on and taking off pressures.

The fourth method was that of boosting up the pressure behind the station governor; and after a long and protracted investigation into the various methods of pressure raising, and the inspection of existing plants, it was decided to instal a turbine-driven fan, as being the most economical method of raising the pressure of a large volume of gas, with the entire absence of oscillation by this type of machine, also keeping in view this fact—that it was only necessary to increase the pressure for a few hours per day, and that only on the occasions of the holder being uncupped. The work was entrusted to Messrs. George Waller and Son, of

Stroud. Their contract also included the supply of all connections, valves, &c., necessary for the satisfactory working of the plant. This installation has now been in use for the past two winters, and has shown itself to be a safe and economical machine for the purpose which it serves. The rated capacity of the plant, as guaranteed by the makers, is 60,000 cubic feet per hour, delivered at a pressure equal to 6 inches water-column. It has been found in practice to be capable of delivering nearly 50,000 cubic feet at a pressure of 10 inches water-column.

The steam-turbine which drives the fan is of the well-known De Laval type, and was made by Messrs. Greenwood and Batley, of Leeds. In this type of turbine, the steam issues from a series of nozzles and immediately impinges on the blades of the turbine-wheel placed in front of, and in close proximity to, the nozzle openings; and the steam-jets, by their kinetic energy, drive the turbine-wheel round. The turbine-wheel is arranged to run at a high rate of speed; this being necessary in order to obtain a good efficiency. The speed of the turbine-wheel is about 30,000 revolutions per minute; and the power developed is about 3 B.H.P. The power is transmitted to a second motion shaft by means of a pair of machine-cut gear wheels, with double helical teeth; the speed being reduced by this means to 3000 revolutions per minute. Steam admission to the turbine is controlled by means of a very compact form of centrifugal governor mounted on the shaft, which carries the larger of the two gear wheels. The shaft carrying the governor is directly connected to the fan shaft by means of a flexible shaft coupling. The normal speed of the fan is, therefore, 3000 revolutions per minute, though this may be varied both by means of the centrifugal governor, which can be manipulated to give speeds varying from 2700 to 3200 revolutions per minute, and also by means of another governor which will be referred to later. Owing to the steam pressure being very variable (60 to 90 lbs.), I decided to pass the steam which drives the turbine through a reducing valve, so as to ensure a constant pressure of 60 lbs.

The fan draws in the gas through a branch which is concentric with its axis, and discharges it tangentially. Both inlet and outlet are 9 inches in diameter. The fan-wheel is built up of steel plate bolted to a cast-iron centre. The fan-spindle revolves in two long swivel bearings mounted on a bracket carried off the body of the fan casing. Both fan and turbine are mounted on a substantial cast-iron baseplate, which is bolted to a stone carried on rolled steel joists; the connections being fixed immediately below. The booster is placed in close proximity to the 18-inch station governor, on the holder side. The exceeding compactness of the plant is a striking feature.

As the plant was not laid down in duplicate, it was necessary to take every precaution against an interruption to the gas supply in case of a breakdown happening to the booster. In arranging the connections, this was guarded against by inserting an 18-inch automatic bye-pass valve in the line of main from the holder to the station governor, and connecting up the booster to branches on each side of it; so that, in case of accident to the booster, the bye-pass valve will at once open automatically and the supply be maintained by the pressure thrown by the holder. The inlet branch passes directly under the booster, and is brought up and connected to it. The 9-inch outlet is taken off at right angles to the inlet, and is carried down to the 18-inch pipes which form a bye-pass to the station governor. Both inlet and outlet are provided with 9-inch rack and pinion valves.

In addition to the 18-inch bye-pass, between the inlet and outlet booster connections, there is also a 12-inch connection by which gas can be bye-passed from the delivery to the inlet side when the pressure at the outlet exceeds a certain predetermined limit. The flow of gas in this bye-pass is regulated by a throttle valve, which is controlled by a diaphragm governor which can readily be adjusted to bye-pass the gas at any pressure which is within the capacity of the booster. The governor and throttle valve are combined in one fitting; and 12-inch rack and pinion valves are provided on each side of the governor to isolate it for examination purposes.

It has already been mentioned that the steam-turbine is provided with a centrifugal governor; but as the function of such a governor is to maintain a constant speed, and not to regulate the speed of the turbine in accordance with the amount of gas which it is desired to pass into the mains, the contractors have provided a special, or what in this case may be termed a primary, governor, for the purpose of regulating the speed of the booster according to the varying gas consumption. This is done by means of one of their improved steam regulator valves, of the equilibrium pattern, and is exceedingly sensitive. This valve is actuated by a diaphragm governor connected up to the gas-main on the delivery side of the booster; so that a rise of pressure will tend to close the regulator valve, and a decrease of pressure to open it. The function of the centrifugal or secondary governer is, therefore, that of a safety device, which only comes into action in case of accident—*i.e.*, it is adjusted to permit the turbine to run at a somewhat higher speed than is necessary to pass the maximum quantity of gas required, so that, under normal conditions, the actual governing of the booster is performed by the primary governor, while in case this should fail, the secondary governor would then come into action, and prevent such a dangerous acceleration of speed as would be destructive to the fan.

It has been found in practice that the primary governor meets all requirements, and maintains a very steady pressure on the mains; but the provision of the centrifugal governor undoubtedly adds to the comfortable feeling of security with which one leaves the whole plant to pursue "the even tenor of its way" for many hours at a stretch quite unattended.

Discussion.

Mr. W. Wilson (Falkirk) asked whether the gearing wheels of the booster were separate, because it appeared to him that, if they were, there was a chance of one of them taking all the strain if the other happened to work slack. He remarked on the excellent method of getting the pressure from the actual gas pressure at the outlet operating the steam-valve, and then throwing the governor turbine out again, practically speaking. As Mr. Bell had said, the governor was really a stand-by—a safety valve.

Mr. John Frazer said they had a very elaborate boosting plant at Provan, with a pressure of 24 inches; and if it was of the compensator type, it would be bound to close or open in the event of the booster stopping. At Provan, they connected up the inlet-valve direct to the 42-inch main, and there were only two valves applicable—the bye-pass valve and the turbine. He thought Mr. Bell had been wise in selecting the turbine booster. He predicted some time ago that the exhauster engine of the future was bound to be of the turbine type. They had been experimenting with it at Provan, and found that they did not lose gas. They had churned the gas over and over again from time to time, and there was practically no difference.

Mr. George Braidwood suggested that in these days of high-pressure gas lighting, with the booster at hand Mr. Bell might introduce an installation of high pressure in his works without much expense. Such an installation would be an advertisement for high-pressure lighting. He could put the high-pressure system in the retort-house, where it would be at work in the very worst conditions among the coal-dust.

Mr. W. Grafton asked Mr. Bell what pressure of gas he sent into the town—was it 4 inches maximum or 6 inches? Two years ago, he had suggested a minimum pressure of 4 inches; but it was believed it would lead to high gas bills. This fallacy had, however, been exploded. On inquiry, he had ascertained that they could find no difference from this increased pressure. He also asked as to the cost of working the plant. Did it amount to ¾d. per 1000 cubic feet? He commended the plant, because it was small, easily worked, went very smoothly, and the wear and tear was excessively small. He also asked how they were going to supply cookers, if they put on an extra supply of gas. Already people were complaining of the cookers smelling so much that they had them returned. This was a pity. He thought it was a very great advantage to have a good deal of pressure, because they had all types of cookers; and if they used them properly there would be no waste and no smell.

Mr. Bell, in reply to the questions which had been put, said the part of the gearing-wheel which was on the turbine-shaft was the forged part of the shaft; and if it was a double wheel, it was in one part. The bye-pass valve of which Mr. Frazer spoke was of the flat type. It had an 18-inch opening, with a flat valve hanging on its face. The gas got out quite freely. They stopped the booster first; and there was no disturbance whatever in the supply of gas to the town. All the valves they had were required. The booster plant was too small to give them sufficient pressure in the town for high-pressure gas.

Mr. Braidwood remarked that he only spoke of introducing high-pressure gas on the works.

Mr. Bell (continuing) said, with regard to advertising high-pressure lighting, there were many good low-pressure gas-lamps giving an efficient light, and there was no electric light competition, so that there was no reason why they should suggest high-pressure lighting that could be of any advantage. They supplied a maximum pressure of 4 inches. He did not believe in going to the minimum, but in having a little extra gas. The cost of running the booster was very small—hardly worth keeping a separate account for. He had reckoned it up; and for oil and attention all the outlay was something like 37s. for a year.

Sampling Coal.—According to a paragraph in the "Chemical Trade Journal," the following directions for the sampling of coal, with the view of obviating the errors not unfrequently made, have been issued by the Carlsruhe Experimental and Research Station, as the result of a number of tests: When a truck is being unloaded, put every twentieth or thirtieth shovelful aside, taking care that the proportion between small and large is fairly representative. The total (say 2 cwt.) thus is spread out on a good firm floor, and stamped to walnut size. It is then well mixed with the shovel, squared-up into a layer from 3·2 to 4 inches deep, and cut across, along the diagonals, into four portions. Of these portions the two opposite ones are taken away. The remainder is further broken up, to about the size of hazel nuts. It is again well mixed up, squared and flattened, and half of it is removed in the same way as before. This is repeated until 22 lbs. remain, which is treated as being the sample required, and is preserved in an air-tight receptacle. If the coal be in store, not less than ten quantities should be taken, at different points, of 55 to 66 lbs. each, to begin with; and if the lumps be large, the first quantity should not be under 6 cwt. The less uniform the coal is, as regards size of lumps, stones, moisture, &c., the larger must be the quantity from which the average sample is drawn, and the more carefully must the breaking-up and mixing be carried on, in order to ensure the ultimate sample being a good average.

SCOTTISH JUNIOR GAS ASSOCIATION.

WESTERN DISTRICT.

The members of the Association paid a visit on Saturday afternoon to the Kirkintilloch Gas-Works, which, through the courtesy of the Corporation, were thrown open to their inspection. The company which left Glasgow numbered between eighty and a hundred members, drawn from all parts of the district.

The works are, one may say, quite new—having been built and opened about three years ago; and from all that has been said about them, they are proving convenient in situation and efficient in every respect. One thing is certain—that the people are very proud of their gas-works, not only on account of their construction, but also because of their economic results. On arrival at Lenzie, the company were accommodated in brakes and driven to the works. There they were welcomed by Mr. H. Alexander, Convener of the Gas Committee. Dividing into two parties, they were conducted over the works by Mr. James Bell, the Manager, and Mr. Dickson, his Assistant.

Beginning with the retort-house, which is 90 feet by 150 feet, it was explained that there are twelve beds of eight retorts; the benches being set back to back, with the view of economizing heat. They are the Waddell type of deep regenerator settings, by Messrs. R. Dempster and Sons, with tubular flues. There is a retort-house governor, by Messrs. Milne and Son. The coal-stores are capable of storing 1000 tons of coal. The gas passes from the retort-house governor through a 15-inch steel main, and then through a 15-inch tar and naphthalene extractor. There are two sets of atmospheric condensers, with 12-inch pipes, arranged so that the whole or part can be put into operation as occasion demands. The exhausters are in duplicate, by Messrs. George Waller and Son, with a capacity of 25,000 cubic feet per hour each; the sunk area underneath giving easy access to the connections. The works are advantageously situated in the vicinity of a bog from which an almost exhaustless supply of water can be obtained; and the water is pumped into an overhead tank capable of holding 36,000 gallons. Attention was drawn to the rotary scrubber, which is used principally for strengthening weak liquor; but it can be brought into requisition as an emergency scrubber whenever necessary. Its capacity is 250,000 cubic feet per day. The purifiers are by Messrs. C. & W. Walker. There are four boxes, 20 feet square by 8 feet deep, fitted with Spencer patent hurdle-grids. There are two lids to each; the joints being of the "Eclipse" rubber type. The purifiers are kept at normal temperature conditions by steam circulating round the outside of the boxes. The station-meter, by Messrs. R. Laidlaw and Son, has a capacity of 40,000 cubic feet per hour. There is also in this house a meter for the works, with "A. & M." long-distance lighting and extinguishing apparatus. The company had an opportunity of seeing the laboratory and photometer and calorimeter room. Coming next to the booster, the members took particular interest in this latest addition to the plant, which was to be described later in the afternoon by Mr. Bell. The station-governor is a 15-inch Foulis pattern, by Messrs. Milne. The sulphate of ammonia plant is by Messrs. Walker, and is capable of producing 1 ton per day. Near by is the tar-well, 25 feet diameter and 14 feet deep, with a capacity of 45,000 gallons.

The inspection of the works completed, the company returned to the brakes, and were driven to the rooms of the Young Men's Christian Institute, where tea had been provided for them by the Corporation. Mr. Alexander again presided; and he was supported by Mr. J. M'Ghee (President of the Association), and Mr. James Bell. After tea,

Bailie Jack, in the absence of Provost Pirie (who was prevented by illness from attending), extended a hearty welcome to the members to Kirkintilloch. They came, he said, for the purpose of mutual benefit, and to see how they could make gas almost for nothing; and then they went elsewhere and told what they had seen. It was a good way of inspecting the latest types of gas plant. He had been twelve years on the Gas Committee, and had had a little to do with gas managers. Three times they had advertised for a gas manager; and when they came to the short leet, he had been amazed to see how anxious they were to make gas, and how much they could take out of a ton of coal. It might come to this—that they might get gas for nothing, and perhaps a dividend for burning it.

A session of the Association was then held, when Mr. J. Bell read a paper on "The Boosting Plant at the Kirkintilloch Gas-Works." This, and some notes of the discussion on it, will be found on p. 297.

Afterwards, a programme of music was gone through.

We learn from the Vertical Gas-Retort Syndicate, Limited, that the Dessau Company have received a further repeat order for Dessau verticals for Zurich (Switzerland) for six beds of eighteen 5-metre retorts—making 108 retorts in all.

In connection with the general illumination of Calcutta upon the occasion of the recent visit of their Majesties the King and Queen, the General Manager of the Oriental Gas Company has received from the Lieutenant Governor of Bengal a communication expressing his Excellency's especial satisfaction with that effected by the Company at Government House.

CORRESPONDENCE.

[*We are not responsible for opinions expressed by Correspondents.*]

The Construction of Gas-Fires.

SIR,—I observe in your issue of Jan. 23 an article entitled "Gas-Fire Construction from Another Point of View," animadverting upon two articles of mine, on "Gas-Fire Construction," which appeared in the "JOURNAL" on Oct. 24 and Jan. 16 last respectively.

My object in writing those articles was clearly stated in that of Oct. 24, as follows:—

> It is not without some hesitation that I venture to offer a number of observations and hints which are the outcome of many years' research work carried on by me in connection with gas-fire construction, and more particularly the construction of gas-fire burners. But I hold the firm conviction, in the first place, that the mistrust of gas-fires which still lingers in the public mind must be removed, if gas-fire heating is to be allowed fair play in gaining the wide popularity it deserves; and, in the second place, that the one way in which this can be brought about is by all gas-fires being constructed not in empirical fashion, as too many still are to-day, but on principles arrived at as a result of scientific investigations, and so fitted to commend gas-heating to the public by its hygienic value, its practical comfort and convenience, and its economy as a heating agent. If the hints I have to offer should be of some help in this direction—as I venture to hope they may, and so subserve the wider interests of gas heating—I believe I shall not in the long run suffer by making them public now.

Writing with this object, I dealt in a judicial spirit, not with any particular apparatus but with principles—setting forth the conclusions which my research work has established.

As I pointed out in my article of Jan. 16, such points as have been laid down are no pious opinions of the writer, but are definitive facts established and demonstrated at every stage by actual systematic testing and analysis. My statements in that article were all (without exception) based on actual tests, not of one fire alone, but of *every* fire that has been placed on the market during the last two years, and of many fires of earlier dates. This I think sufficient refutation of your contributor's statement that "the arguments put forward are based upon, and the conclusions are deduced from, the state of knowledge two or three years ago." Facts admit of neither argument nor controversy; and the result of these tests can be verified by anyone possessing the requisite apparatus and the knowledge of how to use it.

Your contributor's article directly contradicts all my conclusions, in order to defend a type of apparatus in which he is particularly interested, and which he appears to think is attacked. But when a writer publicly links what is ostensibly a technical article with a private firm's advertisement in the same issue, one realizes that his object in writing it is a different one from mine, and that the article is indeed written "from another point of view." A controversy conducted in such a spirit, and with such a manner of treating what are serious scientific questions, is not one to which I would willingly be a party. Your contributor's amazing pronouncements on points of science more than confirm my opinion as to the necessity of such articles as mine, and more than justify my belief in their usefulness to the industry.

In conclusion, let me advise your contributor to test the type of fire he advocates, for radiation and for products of combustion escaping from the canopy into the room, and the result will give him much food for reflection.

H. JAMES YATES, F.C.S., M.I.Mech.E.

Aston, Birmingham, Jan. 26, 1912.

The Water-Gas Plant at the Poplar Works.

SIR,—With reference to my article on the "Effectual Working of a Water-Gas Plant," I should like to point out (to avoid any misunderstanding) that as much as 2,000,000 cubic feet of gas were being obtained from the double plant before it was remodelled, although its nominal make was only 1,700,000 cubic feet.

As regards the present make of 1½ millions from a single remodelled plant, it should be mentioned that while one plant will produce this amount, it has not been possible, up to the present, to get a production of 3 millions from the two plants when working together.

I ought to say that I had special opportunities of obtaining data through the kindness of my chief (Mr. P. E. Williams), the Engineer in charge of the works, who had afforded me the privilege of closely watching the working of the plant.

ALWYNE MEADE.

Poplar Gas-Works, E., Jan. 26, 1912.

The Ilkeston Gasholder Disaster.

SIR,—In reading the report of the inquest upon the unfortunate girl who lost her life in consequence of the Ilkeston accident, one is painfully impressed with the superficial character of the inquiry, and the utter inadequacy of the evidence to substantiate the conclusion arrived at. A disaster of such magnitude, involving loss of life, great public inconvenience, and questions of vast importance to the gas industry and the engineering profession, cannot be satisfactorily disposed of in so off-hand a fashion.

Neither can engineers who have hitherto advocated the advantages of the spiral-guided holder accept as conclusive the dictum of the experts, so light-heartedly delivered, that the Resident Engineer's suggestion is the correct solution of the mystery. I do not wish to imply that any blame for the accident can attach to the Engineer, but the same cannot be said for the hasty manner in which all three engineers appear to have jumped to a conclusion without one tittle of reasoned evidence to support it. Why has not the assistance of an expert in steel manufacture been sought? Did it occur to either of the Engineers consulted to inquire as to the possibility of the inadvertent unsealing of the inner lift by any other means having occurred?

Here we have a holder constructed upon a proved scientific principle, in every respect similar to hundreds of the same type which have been working for many years without a hitch; but because the destruction of this one seems unaccountable in any other way, we are

asked to believe that an element of disaster is inherent in the principle of construction. Those who have charge of spiral-guided holders will agree with the writer in holding that "jamming" is a contingency far more remote in the case of the spiral-guided than the column or frame-guided holder. The Engineer emphatically declares that "the rollers were well oiled and greased;" and this being the case, "jamming" would be nothing short of a miracle.

As one who has not only carefully studied spiral-guided holders, but had considerable experience of their construction and working, the writer ventures to suggest that one or other of the following theories is much more probably correct than the one offered at the inquiry. If the bursting of the tank was consequent upon the falling of the holder, there must have been previous unsealing of the inner lift by some means not disclosed. If the material used in constructing the tank was only of "standard strength," as stated in evidence, a sufficient margin had not been allowed for "unknown strains;" and although "samples" of the steel used gave an average test of ample strength, the plates at the point of rupture were too weak or brittle to stand the extra strain set up by the wind pressure.

There is not a word of evidence to indicate that the ignition of the gas preceded the bursting of the tank; and if the "jamming" theory were correct, no external pressure would be set up by the ignition of gas outside the holder, and the notion that "the firing of the gas had something to do with the bursting of the tank" is absurd.

Jan. 27, 1912. PERPLEXED.

Gas and Electric Cooking—a Challenge.

SIR,—In the "Electricity Supply Memoranda" on p. 205 of this week's "JOURNAL," reference is made to American gas-cookers. In this connection, I may remark that some years ago I had an opportunity of examining one of these cookers. A well-known gas engineer not one hundred miles from Southport asked me to give him my opinion of a gas-stove which had been sent from America; and a more elaborate, got-up-for-show cooker it would be impossible to find. To see it from (say) a distance of 20 feet, one would have imagined it was a piece of furniture from a millionaire's mansion. When I stood at about the distance named from the cooker, the gas engineer said: "Is not that a splendid article?" I replied that if he wished me to give my opinion, I must first examine the apparatus carefully; and this I did. There was one thing about it with regard to which the Americans could beat the English makers—namely, the burners. But in every other respect the best grades of English-made cookers were miles ahead. I therefore told the engineer that I would not have the cooker as a gift, as I wanted a gas-oven for use, and not for show. Thereupon, turning to a clerk who was about to be married, he offered it to him as a present. The clerk, however, declined it with thanks—remarking that, after the explanation he had heard, it seemed that, the oven not being packed, the heat would make the house unbearable. The cooker stands to-day in the stores of the gas company.

I note in the same article in the "JOURNAL" a reference to Mr. F. S. Grogan—a lecturer of the "Tricity" cookery sets. He must be more than a lecturer, for he mentions efficiency tests, and says that "when cooking, the escaping heat, poisonous fumes, and smell, give the person using the gas-cooker a headache." Of course, it is easy to make these statements, but another thing to prove them. Now, Mr. Grogan, as I am not in the employ of any gas-stove maker, are you prepared to enter into a practical test under the following conditions?

You to use an electric oven; while I will use a gas-oven. You to give your lecture, and make and bake (say) six different things. I mention these as useful for the average family: A leg of mutton, two loaves of bread, an apple pie, a rice pudding, a Yorkshire pudding, and a sponge sandwich—all to be baked during the time the meat is roasting. Both ovens to be new ones. There are to be no smell and obnoxious fumes. Both ovens to be free from grease and quite clean after the tests. The meat to be weighed in and out of the ovens. The actual cost for the roasting and baking by both methods to be carefully noted. The test to be carried out openly in any public hall wherein you can give your lecture and demonstration, and I will do the same. Invitations to be given to all possible who are in any way interested, as well as to representatives of the Press.

Now, Sir, will you meet me on these lines, so that not only electricians and gas people may see what can be done, but that the public can have a true test of the two methods? If I fail to turn out better baked food at less cost than you, or anyone you can find, I will publicly hand you £20. You will hand me the same amount if you cannot do with your electric oven what I can with my gas-oven. The air needs clearing a little of smoke—please name the day, time, and place.

6, Blair Grove, Southport,
Jan. 25, 1912. R. G. MARKS,
Gas-Stove Specialist.

Gas Companies as Chemical Manufacturers.

SIR,—London manufacturers, having no Parliamentary Committee, Bills in Parliament and the terms of clauses do not come under trade consideration unless the opportunity is taken on such occasions as the meeting of the Chemical Trade Section of the London Chamber of Commerce.

I opened a discussion at the last meeting, which you report and comment on in the "JOURNAL."

It has hitherto been understood that the powers of chemical manufacture granted by Parliament to gas companies were limited by the words "manufacture of gas" to products derived from the manufacture of the company's *own* gas. So long as this limitation is observed, chemical manufacturers are not likely to be in opposition to gas companies. If, however, by the insertion of "purchase" or other words in new Gas Bills, it becomes possible to give an extended interpretation to such powers, the importance to chemical manufacturers is obvious. A point of substance, and not a "mare's nest," is involved.

14, Park Crescent, W., Jan. 25, 1912. WM. PEARCE.

[Apart from the fact that there are precedents for the insertion of the word "purchase" as applying to residuals in the general purposes clause of gas companies, we are afraid that Mr. Pearce is endeavouring to give a very narrow interpretation to the powers of a gas company, by suggesting that they are limited in their business in residuals by the words "manufacture of gas" to products derived from the manufacture of the company's "own" gas. Nowhere in the Acts of Parliament is there the suggested limitation in regard to residuals; and strange indeed is it to us that the chemical manufacturers have only just found it necessary to intervene in this matter. In addition to what is done by those companies who work up their own residuals, it has been a not uncommon practice for gas undertakings to "purchase" from other gas-works the chief residual, coke, when required for the filling of contracts, and some works that have had a heavy demand upon them for tar for road purposes have also had to cover their obligations by "purchasing" from other producers. They are within their rights, whichever form of general purposes clause they are working under—whether under the clause containing the word "purchase," or the clause that strictly complies with the model. The model clause says the company "may *provide*, produce, sell, dispose of, and *deal in* gas, coke, tar, and *all other* residual products resulting from the manufacture of gas, and *generally* may carry on the business usually carried on by a gas company." We cannot agree with the narrow interpretation put by Mr. Pearce upon this statutory power. We wonder what meaning he attaches to the word "provide" placed as it is before the word "produce," and to the term "deal in." "Deal in," it seems to us, includes both purchase and sale. We have never heard of a dealer who only sells and never buys. The words "sell" and "dispose of" already appear in the clause; so that "deal in" would be a redundancy if it only carried the meaning that the company might "sell" or "dispose of" their own secondary products. We agree that a point of substance is involved (for gas companies) in the belated discovery of the chemical manufacturers; and we still submit that, all things considered, the latter have stumbled upon a mare's nest.—ED. J.G.L.]

Limiting Gas Profits—Beware of Old Acts of Parliament.

SIR,—From the answer given by Mr. E. H. Stevenson to a question put by Mr. Corbet Woodall during the Aberavon and Margam Gas arbitration (as reported in last Tuesday's "JOURNAL," p. 233), it would appear as if the Oldham Act of 1886 was never acted upon; but, strictly, this is not quite so. The following facts are a fairly true account of the position, considering the time that has elapsed.

In 1882, the Chadderton Local Board (one of the eight out-districts supplied by Oldham with gas and water) promoted an Omnibus Bill in Parliament, one section of which sought power to erect gas-works in their own district, to purchase the mains, &c., from the Oldham Corporation, and to make an entire severance so far as the gas supply was concerned. The gas section of the Bill was thrown out—chiefly, I believe, on the evidence that, as Oldham also supplied Chadderton with water, on which there was a yearly loss, it would be unfair to take away from the Corporation the supplying of gas, on which there was a profit.

In 1886, the Oldham Corporation promoted an Omnibus Bill, in which they sought additional gas powers. The Bill was opposed by all the out-districts, with the result that a clause limiting the gas profits was inserted. Shortly after the Act had received the Royal Assent, it was discovered accidentally that there was a clause in the Oldham Corporation Act of 1853 (the Act authorizing the purchase of the Oldham Gaslight, Coke, and Water Company) which gave the Corporation power to light the streets and public buildings free of charge to the rates. The Corporation proceeded to act on this; and in later years, when they also became the Education Authority, the schools were all treated in the same manner—*i.e.*, the Gas and Water Departments bearing the cost of all gas and water consumed at the schools.

Subsequently, the Chadderton Local Board took the Oldham Corporation before the High Court of Justice, to compel the Corporation to carry out the clause in the Act of 1886 limiting the amount of profit they made on the gas supplied. The Court decided in favour of the Corporation and the Act of 1853. Thus the clause in the Act of 1886 was void until after the Act of 1909.

The limitation clause in the Oldham Act of 1886 was not in the Bill as deposited, but was a matter of negotiation during the sitting of the Committee of the House. Hence it was that no one thought of looking up the contents of old Acts of Parliament.

Jan. 24, 1912. ANCIENT BUT INTERESTING HISTORY.

Technical Assistants' Pay.

A correspondent, who does not desire his identity to be disclosed, writes (in regard to the letter with the above heading that appeared in the "JOURNAL" for Jan. 16, p. 159): "You may say how could anyone think that the salary offered was a decent wage;" and then he points to the experiences in his own career. He remarks that he entered the service of a gas supplying corporation when in his twentieth year, after having undergone a somewhat expensive technical education, during which he had, of course, not earned a penny. He started at 27s. 6d. per week, and five years later had £2 per week. He thus had to watch the "stately procession of half-crowns, five in number, reaching my length in five long years." Our correspondent mentions that at the works referred to in the advertisement he is able to say that there is a fairly highly-paid assistant-manager, and also a trained chemist, so that the duties of the office advertised were not particularly onerous. He concludes by saying: "It is surely too late in the day to point out, as your correspondent does by inference, that there is scarcely anything on earth cheaper than education."

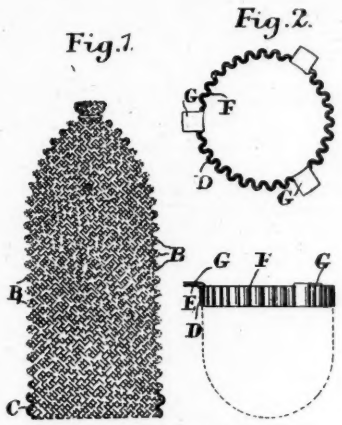
REGISTER OF PATENTS.

Incandescent Gas-Mantles.

MATTHEWS, W. C., of Stafford.

No. 29,656; Dec. 21, 1910. No. 14,061; June 13, 1911.

This combined invention relates to upright and inverted mantles of the type in which the mouth or gas inlet end is strengthened with a metallic band of V shape in section. The invention is limited to corrugated mantles of either single or double form. If of double form, one of the mantles may be of plain construction. The invention consists in the combination of features described; no claim being made for double mantles *per se*.



Matthews' Incandescent Mantles.

Fig. 1 shows a mantle in vertical cross section having substantially horizontal corrugations B, to the lower end of which a metallic sleeve C is fitted. The drawing shows how the mantle and sleeve are held together by the corrugations.

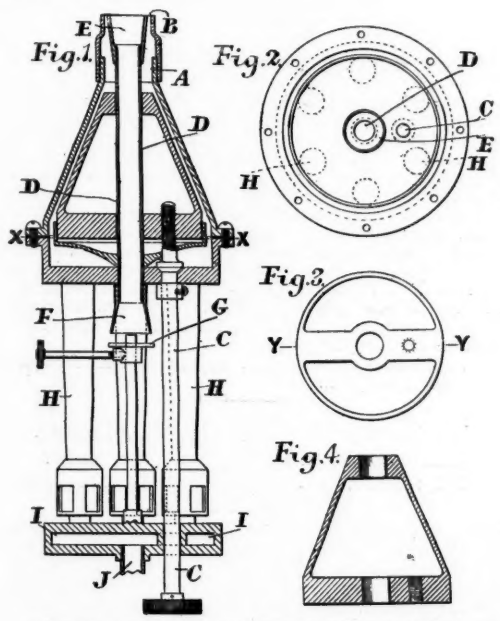
Fig. 2 shows the open or gas inlet end of a vertically corrugated mantle to which a double corrugated sleeve D F is fitted; the portion F having tongues G bent outwardly above the tongues E on the portion D.

Atmospheric Gas-Burner.

TOOTH, L. F., of the Commercial Gas Company, Stepney.

No. 29,812; Dec. 22, 1910.

This atmospheric gas-burner has a cone valve and cone surface in the mixing-tube, so that "a perfect ring flame (not jets) shall be produced and the supply of air to the gas mixing tubes or chambers may be regulated by moving the cone valve according to the pressure or quality of the gas, and a regulatable supply of air be supplied to the interior of the ring or tube of flame."



Tooth's Atmospheric Gas-Burner for Furnace Work.

Fig. 1 is a longitudinal part section of the burner. Fig. 2 is a section on the line X. Fig. 3 is an under plan of the valve. Fig. 4 is a section of the valve on line Y.

The conical casing of the burner has a contracted outlet or mouth A at the apex leading to a chamber somewhat larger in size and having an outlet B about the same size as the mouth of the chamber—this outlet forming the burner orifice. Inside this conical chamber is a conical valve, the cone corresponding to, or being slightly different from, the conical interior of the chamber. It is operable from outside by a screw rod C to position it with regard to the interior conical wall of the chamber. Through the valve and chamber a tube D passes, both ends of which are conical, one end E being positioned in the burner orifice and flush with the walls of the extension of the conical chamber, so that the gas and air in flame form issue from the ring space formed between. The other end F of the pipe is outside the chamber, and is provided with means, such as a disc valve G, fixed to a screw rod, for regulating the air passing through the tube. Into the bottom of the conical chamber are led two or more bunsen tubes H, connected at their other ends to a box I, for receiving their supply of gas from a gas supply pipe J. These bunsen tubes are preferably made conical inside, with the larger end next the burner end.

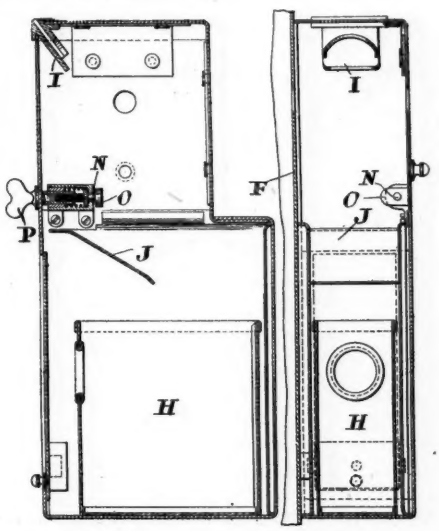
The gas and air mixture passing from the bunsen tubes H into the conical chamber is regulated in its passage between the valve and the casing according to the quality or pressure of the gas, so as to ensure a proper quantity of air being drawn in and mixed with the gas in the bunsen tube. The mixture emanating as a gas-flame from the ring orifice at the end of the extension, and likewise the supply of air to the interior of the flame due to suction of the flame, is regulated by the disc valve G.

Money Boxes for Prepayment Meters.

HANSFORD, J., of New Barnet, and WRIGHT, A. C., of Witton, near Birmingham.

No. 30,013; Dec. 24, 1910.

The object of this invention is to provide "a substantially burglar-proof cash-box for prepayment meters."



Hansford and Wright's Prepayment Meter Cash-Box.

Vertical sections of the box (at right angles to each other) are given. In them the bottom, front, end, and top plates are of sheet steel hardened. There is no back-plate since the box is to be secured to the casing of a meter as at F. The box has an inner lining of tin plate, between which and the steel plates on the one hand, and the casing of the meter on the other, are spaces filled with refractory material to render the box "practically fireproof." The only side which need be left unlined is the side C, in which is fitted a sliding door giving access to the coin receptacle H. The top of the box must be open for the passage of the coins from the coin-shoot I. The aperture between this space and the money-box is filled up with the prepayment mechanism. To ensure that access cannot possibly be obtained to the cash in this way, there is a projecting ledge J extending over the top of the cash receptacle. The door which commands access to the prepayment mechanism is secured in place by a tenon and a spring bolt N mounted on the casing and co-operating with a lug O on the door. This spring bolt has a multiple screw-thread at its inner end. The key P, whereby it is withdrawn, is tubular and similarly screw-threaded internally for engagement with the bolt.

Inverted Incandescent Gas-Lights.

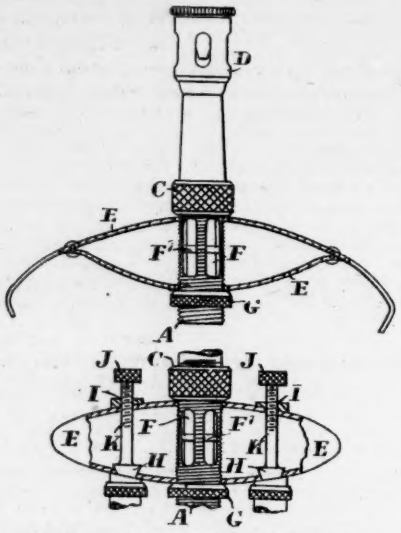
CHALLIS, J., of Hampstead, and STEPHENS, K., of Manor Park, Essex.

No. 29,973; Dec. 24, 1910.

This invention relates more particularly to the tube connection of the intensifying chamber for the mixture before it reaches the burner. In order to effect complete diffusion of the mixture in the intensifying chamber through a continuous tube-connection within the chamber, the patentees adopt a lens-shaped chamber formed of bulging or convex top and bottom plates connected together. The bottom plate forms a reflector, with arms for carrying the globe.

The lens-shaped chamber has central perforations in its opposite walls for the passage of the mixing-tube connected with the mixing-chamber. This tube is externally screw-threaded for a sufficient length to extend beyond the intensifying chamber on each side and form a lower nipple for the attachment of the burner-head and mantle-carrier. The portion of the mixing-tube within the intensifying chamber is so

cut away as to provide rectangular openings for the ingress and egress of the gas mixture into and from the intensifying chamber; and between the ingress and egress is a plate or baffle in the mixing-tube, "to more effectually spread the gas and air mixture and to positively prevent the straight flow of the latter through the mixing-tube instead of circulating through the chamber."



Challis and Stephens' Inverted Gaslight.

The illustration shows an axial section of the lens-shaped chamber with the slotted mixing-tube in position; also a sectional elevation of a chamber fitted with burner-tubes controlled by valves.

The tube A is fitted with a union-nut C by means of which it is secured to the end of the ordinary mixing pipe or to the bunsen tube D. The tube A extends through the lens-shaped intensifying chamber E, with elongated slots within it (such as F), through which the gas enters and leaves the chamber. The tube A, which is intercepted by a plate F^1, is rendered gas-tight in the upper and lower wall of the chamber E, and is externally screw-threaded so as to receive a nut G or the like for locking it to the chamber. The protruding end portion of the tube A forms a screw-connection for the burner-head.

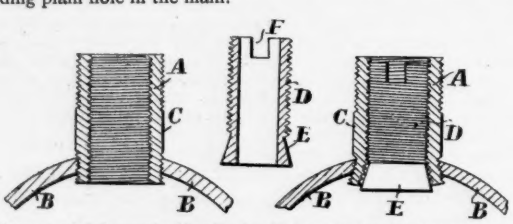
When several additional burner-heads are connected with the same intensifying chamber E, each additional outlet in the latter is provided with a regulator or stop-valve H fitted in the upper wall of the chamber, which may be effected by screwing, as at I. The heads J or valves H are separately attached to stems K for facility of removal. The central tube A (being fitted with a burner-head) requires no valve.

Connecting Service Pipes to Gas and Other Mains.

STONE AND CO., LIMITED, of Deptford, and JAKEMAN, G. E., of Peckham, S.E.

No. 30,022; Dec. 24, 1910. No. 16,863; July 22, 1911.

This "combined" invention relates to nipples for connecting service pipes to gas and other mains—such nipples being of the type which, after insertion in the main, are expanded at their ends within the main in order to make a tight joint. The invention also refers to the construction of a key or tool employed for screwing the mandrel within the nipple, and means for preventing the rotation of the nipple within the hole in the main during the operation of expanding the lower end of it; also to means for ensuring a perfectly fluid-tight joint where the nipple enters the main, especially in the case where the lower end of the nipple is formed with a plain external surface to engage a corresponding plain hole in the main.



Stone and Jakeman's Nipples for Main and Service Connection.

In the construction shown, the nipple consists of a short length of pipe A, screw-threaded on its exterior at its lower end, and adapted to be screwed into a screw-threaded hole in the main pipe B, the other end of A being also externally screw-threaded to receive a screw-threaded socket (preferably a reducing socket) or other appropriate connection for the service pipe. Between the screw-threaded ends of the nipple a portion of the pipe is preferably left plain, as at C, so as to be engaged by a pipe wrench when the nipple is being screwed into the main; or the portion may be polygonal to accommodate a spanner. The lower end of the nipple is screw-threaded for such a distance that when it is screwed into the main, it projects beyond the interior surface (say) $\frac{1}{8}$ inch. The interior of the nipple is provided throughout its length with a screw-thread, the direction of the pitch of which is preferably opposite to the screw threads on the exterior.

D is a hollow mandrel formed for the greater part of its length with an external left-hand screw-thread, while its lower end is formed with a plain, tapered, or conical part E the smaller and upper end of which taper may be of a diameter corresponding to the diameter of the screw-thread on the mandrel, or slightly less. The larger lower end of the tapered part is, however, of slightly larger diameter than the screw-thread. The hollow mandrel is screwed into the lower end of the nipple up to its tapered part prior to the nipple being screwed into the main, after which the mandrel is further screwed upwards into the nipple, so that the tapered part engages the interior surface of the lower end of the nipple, which projects within the main, and forces the end of it to make a tight joint with the main surrounding the nipple, and also causes the end of the nipple to be splayed outwardly within the main.

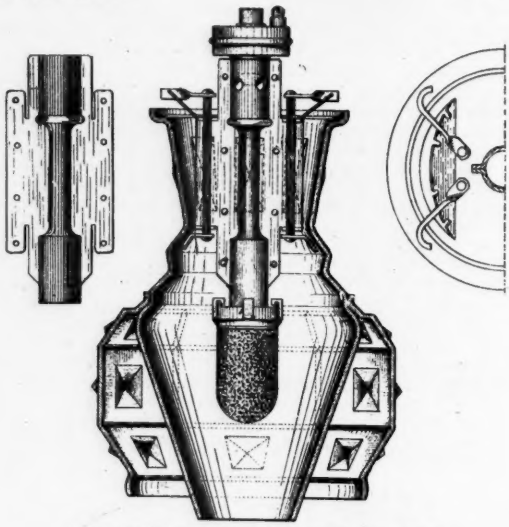
For the purpose of screwing the mandrel upwardly within the nipple when in position on the main, the upper end of it has in it a transverse slot F, adapted to receive a transverse projecting-tooth on the lower end of a cylindrical key of such diameter as to loosely fit the internal diameter of the nipple. On turning the key (owing to the fact that the internal and external screw threads of the nipple are of pitch of opposite directions), the tendency during the screwing of the mandrel into the nipple will be to screw the nipple tighter or further into the main rather than to unscrew it.

Inverted Incandescent Gas-Lamp.

LENTSCHAT, G., of Berlin.

No. 11,921; May 17, 1911.

In ordinary inverted incandescent gas-lamps, the patentee remarks, the burner-tube is composed of several tubes screwed one into the other, whereby shoulders are formed, which resist the current of gas. In general, the pressure of the mixture of gas and air in the burner-tube is very small; so that the loss of pressure produced by the shoulders considerably reduces the pressure of the mixture and "the good effect of the lamp is necessarily impaired." Further, the devices provided on the ordinary burners for holding the chimney or globe are "usually so arranged that the fastening screws engage from without into a groove of the chimney or globe, so that during the action of the heat of the flame the chimney or globe is prevented from expansion and is very apt to break."



Lentschat's Inverted Incandescent Gas-Lamp.

His invention is one "whereby the said defects are avoided." The burner-tube is made, as shown, in two flanged halves, connected together after the insertion of packings between the longitudinal flanges. Then the current of gas mixture finds a smooth passage; so that the loss of pressure due to friction will be reduced to a minimum. The flanges of the tube halves have ears, in which parallel spindles are mounted to rock. A disc is put on the upper ears for engaging in an inner recess of the chimney or globe; and thus centring the latter, and is provided with outlets for the products of combustion. Bent arms are fashioned at the lower ends of the spindles for engaging beneath an inner shoulder of the chimney or globe, so that the latter is permitted to freely expand and contract. Adjusting arms are fastened at the upper ends of the spindles for leaning the bent arms against the inner shoulder of the chimney or globe.

The arrangement referred to will be appreciated from the illustration without further description.

Lighting and Extinguishing Gas-Lamps.

JULIUS PINTSCH AKTIENGESELLSCHAFT, of Berlin.

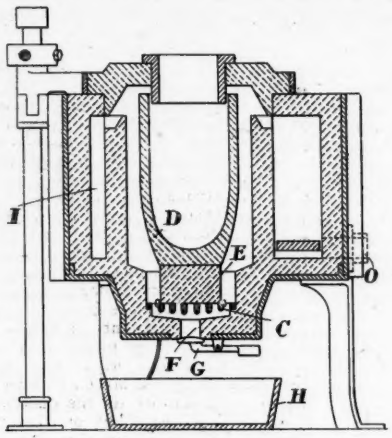
No. 28,584; Dec. 8, 1910. Date claimed under International Convention, Dec. 17, 1909.

This device for lighting and extinguishing lamps is more especially applicable to railway carriages. The pilot light is fed by two supplies, of which one is always on and the other passes through a gas-receiver and is automatically cut-off behind the receiver, when the cock is turned into the "on" position. Thus the pilot light burns with a normal flame when the main burner is out, but with a reduced flame when the main burner is alight. The arrangement is also such that the gas present in the receiver when the cock is put to the "on" position is caused to flow to the pilot light, which burns for a short time longer with a normal flame for the purpose of igniting the burner. The device is more particularly advantageous in the case of lamps having pilot jets at such a distance from the burner that they must have a flame of considerable size in order to ensure the ignition of the main burner flame.

Gas Crucible Furnace.

YATES, H. JAMES, of Aston, Birmingham.
No. 3640; Feb. 13, 1911.

The furnace body is constructed from refractory material contained in a cast iron case or shell. At the base of the central chamber for the crucible (which is open at the top and provided with a detachable cover) is a grid C, to support either the crucible D or a block E on which the crucible stands. An opening F is formed in the furnace bottom beneath the grid; and under the outer end of the opening is hinged a counterweighted cover piece or flap valve G. Normally, the opening is closed by the valve under the action of its counterweight;



Yates's Gas Crucible Furnace.

but in the event of accidental collapse or breakage of the crucible, the contents flow through the grid to the opening in the furnace bottom, and by their weight on the valve depress it and pass away into a pan H beneath the furnace. Choking of the air and gas aperture or apertures at the lower end of the crucible chamber is thus avoided, as well as "any serious loss of the crucible contents, which is an important consideration when precious metals, such as gold and silver, are being melted."

Before escaping to atmosphere, the hot gases are conducted through passages I formed in the walls of the crucible chamber for the purpose of providing a hot jacket for the latter and enabling a high temperature to be maintained "with an economical consumption of gas." The gases pass away from the jacket through an outlet O.

APPLICATIONS FOR LETTERS PATENT.

1211.—STENNETT, E., "Production of air gas." Jan. 16.
1214-5.—BETH, W. F. L., "Purifying air and gases." Jan. 16.
1230.—GRIMSHAW, S. G., "Artificial fuel." Jan. 16.
1232.—LYMN, A. H.. and RAMBUSCH, N. E., "Gas-producers." Jan. 16.
1238.—EPSTEIN, G. J., "Utilization of heat and light." Jan. 16.
1260.—BUTLER, C., "Acetylene generators." Jan. 16.
1266.—BARRALET, J. H, "Gas-cocks." Jan. 16.
1267.—BARRALET, J. H., "Geysers." Jan. 16.
1271.—NORTH, R. B., "Pressure-gauges." Jan. 16.
1282.—HILL, F. B., and WESTWOOD, G. J. W., "Making a combustible heating and illuminating gas." Jan. 16.
1285.—AKTIEBOLAGET LUX, "Lighting and extinguishing gas from a distance." Jan. 16.
1310.—CUSS, C. T., "Incandescent lighting." Jan. 17.
1347.—DUCKHAM, A. M'D., "Vertical retorts." Jan. 17.
1348.—KEITH, J. & G., "Gas-lamps." Jan. 17.
1367.—ZECHNALL, L., "Mantles." Jan. 17.
1370.—FALK, S., "Inverted burners." Jan. 17.
1398.—HARDY, G., "Safety devices for oil or gas fired steam-boilers." Jan. 17.
1400.—TODMAN, J. C. T., "Controlling the flow of liquids or gases." Jan. 17.
1407.—STOTT, J., "Burner-top and mantle-holder." Jan. 18.
1452.—GLIMPEL, R. & G., "Distant-lighter." Jan. 18.
1455.—STILL, W. M. AND SONS, LTD., and ABBOTT, F. E., "Air-gas apparatus." Jan. 18.
1456.—KERPELY, A. VON, "Gas-producers." Jan. 18.
1469.—PHILIP, A., and STEELE, L. J., "Detectors of combustible gases." Jan. 18.
1473.—HUMARAN, F. G., "Gas-turbines, &c." Jan. 18.
1480.—SMITH, W. R., "Gas-burners." Jan. 18.
1553.—BIHELLER, S, "Globe-rings." Jan 19.
1559.—SOUTH METROPOLITAN GAS COMPANY and CHANDLER, D., "Atmospheric burners." Jan. 19.
1589.—WHITMILL, W. H., "Removal of obstructions in pipe systems." Jan. 19.
1608.—STETTINER CHAMOTTE-FABRIK AKT.-GES., VORM DIDIER, "Retort-furnaces." Jan. 20
1609.—HARROP, G., "Holding globes." Jan. 20.
1622.—MARCHETTO, L., "Safety-valve for preventing leakage of gas." Jan. 20.
1657.—BERGASSE, P. H., "Petrol-gas systems." Jan. 20.
1666.—MOLIEN, H., and BRITISH MANNESMANN TUBE COMPANY, LTD., "Pipe-couplings." Jan. 20.

The Beaufort and District Gas Company, Limited, was registered on the 20th inst., with a capital of £7000 in £1 shares, 3000 of which are preference.

PARLIAMENTARY INTELLIGENCE.

LEGALITY OF FREE-WIRING AGREEMENTS.

The Bill of the National Electric Construction Company, by which it is sought to make valid a number of agreements with local authorities relating to the free wiring of consumers' premises, came last Thursday before Mr. JEUNE, one of the Examiners of Standing Orders proofs. As already intimated in the "JOURNAL" [*ante*, p. 237], a memorial complaining of non-compliance with the Standing Orders had been deposited on behalf of the Swansea Gas Company and the Canterbury Gas and Water Company.

Briefly, the promoters of the Bill seek to legalize some two dozen agreements with local authorities and electric supply companies, under which the National Electric Construction Company and their predecessors, the National Free-Wiring Company, agree to instal electric wires and fittings in consumers' premises; the electricity supply authority making an additional charge of 1d. per unit to the consumer, and paying it over to the Construction Company. The preamble of the Bill sets forth that doubts exist as to the legality of such agreements; these doubts having arisen mainly in consequence of the judgment given in 1910 by Mr. Justice Nevill, in the Chancery Division of the High Court of Justice, in the action brought by the Electrical Contractors' Association against the Leicester Corporation. This decision, which has not been appealed against, was to the effect that a local authority cannot deal in the wiring and fitting of consumers' premises under the Electric Lighting Acts, and that special parliamentary authority must be obtained to enable them to do so. Following upon this, the Construction Company were directly concerned in an action in the Canterbury County Court, where it was held that, in consequence of the decision above referred to, the Canterbury Corporation agreement with the Company was *ultra vires*. The Company thereupon promoted the present Bill, which is also made applicable to all the other agreements into which they have ever entered. It may be pointed out that none of the authorities or companies concerned in the agreements opposed the Bill on Standing Orders. The following is a list of the places where these agreements exist: Bangor, Belfast, Blackpool, Bo'ness, Canterbury, Carnarvon, Coventry, Crewe, Crystal Palace District (now South Metropolitan Electric Light and Power Company), Fleetwood, Gloucester, Hackney, Hornsey, Lincoln, Pembroke, Poplar, Rathmines, Redditch, Shoreditch, Swansea, Taunton, Tunbridge Wells, Wallasey.

Mr. R. W. COOPER, (Messrs. R. W. Cooper and Sons) for the memorializing Companies, first submitted that the notices for the Bill were insufficient, inasmuch as, though the full list of towns concerned was advertised in the London papers, in the local papers only the agreement relating to that particular town was mentioned.

Mr. A. J. LEES, Parliamentary Agent for the promoters, contended that the notices were sufficient, and said that, in fact, he was not bound to give local notices at all.

Mr. COOPER said that the Standing Order which Mr. Lees relied upon (No. 9) related specifically to lands or works in more than one county. In that case, he admitted, there was no need to set out in the local notices particulars relating to works in another county. In the present Bill, however, no land or works were involved.

Mr. LEES replied that the Standing Order in question also referred to Bills promoted by a company possessed of an undertaking in more than one county. He submitted that he had complied with the Standing Orders by giving the full notice in London, where the head-quarters of the Company were situated. Further, he referred to the case of the Basingstoke and Estrop Water Bill in 1883, and to the Nantwich Urban District Council Bill in 1903, where this principle had been laid down and never departed from.

The EXAMINER said it was not necessary for him to decide the point whether the promoters, under the circumstances, were bound to give notice outside the county where their head-quarters were. They had chosen to give a short notice in all the districts affected by the Bill; and he thought this was sufficient. The allegation of non-compliance in this respect was therefore not sustained.

Mr. COOPER next made an allegation in respect of the notice given in the Canterbury local paper. While this stated that the Bill proposed to alter or amend the Canterbury Electric Lighting Order, the subsequent list of Orders set out did not include the one relating to Canterbury.

Mr. LEES said this was a printer's error; but as a matter of fact, no powers were asked for in the Bill to amend any of the Electric Lighting Orders in the towns affected. It had originally been the intention to do this; but the idea was abandoned.

Mr. COOPER claimed that the fact of legalizing the agreements must indirectly amend the Order, as it made certain acts legal which were now illegal.

The EXAMINER held that as the promoters had seen fit to give local notices they must be correct. He must therefore report non-compliance with Standing Orders on this point.

Mr. COOPER next came to the agreement. He pointed out that the notices all stated that specific agreements were to be legalized; but their details were not given. Any person affected would therefore turn to the Bill, but would find that whereas in Schedules 1 and 2 certain agreements were set out in full, in Schedule 3 there was merely a list of towns the agreements in respect of which were to be legalized, without any reference to what the agreements contained. In these circumstances, he claimed that the notices were insufficient, and that the whole of the particular agreement should have been included. As matters stood, a consumer in any town whose interest might be vitally affected could not find out what the agreements contained.

Mr. LEES said the list of towns set out in the third schedule had agreements precisely similar to the one at Canterbury, which was set out in full in the Bill. Furthermore, the consumer was not affected, as the agreements to be confirmed were all between the Company and the respective local authorities; and both parties had the agreement

in their possession. Surely, therefore, it would have been an unnecessary expense to set out all the 24 agreements in full in the Bill. He finally contended that it was not a matter for the Examiners, but for the Chairman of Committees to decide whether the agreements should all be scheduled to the Bill.

Mr. COOPER pointed out that the preamble of the Bill stated that the agreements mentioned in the third schedule varied somewhat in terms; and therefore it could not be said that they were identical with the Canterbury agreement.

Mr. LEES said they only varied in minor details.

The EXAMINER asked if the public in all the towns were not entitled to know the precise agreements which were to be made legal.

Mr. LEES thought not, as the agreement in each case was not with the consumers but with the supplying authority.

The EXAMINER, in giving his decision, said it would not have been necessary to set out at all the agreements in the notices, if they had been scheduled to the Bill; but as the terms of the agreements in Schedule 3 were neither in the notices nor in the Bill, he would be bound to report non-compliance with Standing Orders. If all the agreements had been identical with the Canterbury one, the result might have been different; but the preamble of the Bill said they varied in terms. It was not his duty to inquire how they varied.

Mr. COOPER next claimed non-compliance from the fact that a notice appeared in the "Western News," of Taunton, on Nov. 28, whereas the last day for the publication of notices was the 27th.

Mr. LEES brought evidence to show that the newspaper in question was always published a day before the date it bore.

The EXAMINER decided that the allegation was not sustained.

Mr. COOPER finally alleged that separate notices ought to have been published in the London boroughs which have agreements with the promoters.

The EXAMINER held that the publication of the full notice of the Bill in two London newspapers was sufficient.

The petition for the Bill will therefore be reported to the Standing Orders Committee on the points mentioned.

LEGAL INTELLIGENCE.

Embezzlement Charges against a Clerk.

The Chesterfield Magistrates last week committed for trial Walter Hartley, a clerk, who was charged with embezzlement and falsification of accounts by the Chesterfield Gas and Water Board, by whom he had been employed for fifteen years. The charges of embezzlement related to about £15, though it was stated that the prisoner had received altogether £485 for which he had not accounted. In 1903, he was appointed collector to the Board; and his salary at the time of the discovery of the alleged defalcations was £2 10s. per week. The charge of falsification concerned the making of wrong entries in the counterfoils of receipt-books.

Compensation Case at Bromsgrove.

On Monday of last week, at the Bromsgrove County Court, before Judge Ingham, a labourer named George Lammes made an application under the Workmen's Compensation Act in respect to an accident sustained while laying gas-mains for the Bromsgrove Gas Company. Liability was disputed by the Company. On behalf of the applicant, it was stated that while he was working for the Company, at a wage of 3s 4d. a day, a fellow-workman wounded his right hand by striking it with a pickaxe. This occurred in April last; and he was still without the full use of his hand. The Company paid him 10s. a week for six months after the accident, and then offered him work at removing and stacking coal, which he was unable to do. He had earned a few shillings by potato digging. Dr. Coaker explained that, as the result of the accident, the applicant had two contracted fingers, which would give him great pain if he did navvying work. In his opinion, the applicant would be unable to do coal stacking; and he was afraid the injury was permanent. Mr. A. Bird (the Manager) said he had offered applicant work at coal stacking at 3s. 2d. per day, and suggested he should fill up his time about the place; but applicant did not attend at the works. An order was made for payment of 5s. a week from Oct. 28.

The "Gassing" Fatality at Rochdale.

At the Manchester Assizes last month, Mr. Justice Lush heard an action which arose out of the loss of two lives by "gassing" in a culvert at Rochdale. The plaintiffs were the Mayor and Corporation of Rochdale, who sought to recover from the Trustees of the Rochdale Market Company a sum of £329, money paid as compensation and costs to the representatives of Thomas Harris, one of the men who died from the inhalation of poisonous fumes while working in the culvert. The case for the plaintiffs was that Harris died from the effects of carbon monoxide, which they alleged the defendants turned into the culvert from the exhaust-pipe of a gas-engine working on their premises. Defendants pleaded that the gas was sewer gas which was in the culvert. At the conclusion of the hearing (a report of which appeared in the "JOURNAL" for Dec. 19, p. 843), judgment was reserved. Mr. Justice Lush has since decided in favour of the defendants, to whom costs have been given. He said that the questions raised before him were whether Harris met his death in circumstances creating a liability on the part of the defendants towards his relatives, and whether the Corporation were precluded from recovering owing to their own negligence or contributory negligence. The case was a peculiar and somewhat mysterious one from a medical point of view; for, remarkably enough, the men walked about in fresh air for some hours after exposure to the gas. Harris died from sewage gas, which existed in great quantities in the culvert. This was the active cause of both deaths. The plaintiffs had failed to establish their right to an indemnity. They had not satisfied him that such carbon monoxide as there was in the culvert was produced by the defendants' gas-engines, nor was it proved that the engines were in any way out of order.

MISCELLANEOUS NEWS.

ILKESTON GASHOLDER DISASTER INQUIRY.

Probable Causes of the Accident.

The adjourned inquiry into the circumstances attending the death of Deborah Matilda Gough, which occurred as a consequence of the gasholder accident at Ilkeston, of which particulars have been given in the two preceding issues of the "JOURNAL," was held in the Town Hall, Ilkeston, on Tuesday last, by Mr. W. H. WHISTON, the Derby District Coroner.

After a brief narration of the immediate circumstances connected with the fatality, the inquiry, which lasted more than three hours, was directed to considerations of a technical nature as to the construction and stability of the holder, the contributing factors to the fracture of the tank, and other matters; the principal witness, whose examination occupied the greater part of the time, being Mr. Samuel Glover, of St. Helens—he having, as already mentioned in the "JOURNAL," with Mr. J. Ferguson Bell, of Derby, been called in on the day following the explosion, to advise the Corporation on the matter. By the aid of tin-made models, Mr. Glover, whose report was given last week (p. 204), afforded a very comprehensive illustration to the non-technical minds of the gentlemen forming the Jury; his evidence being amplified by that of Mr. Bell, and a verdict following which embodied entire acceptance of the professional views expressed. The major portion of the examination of the witnesses as to the possible origin of the accident and the scientific considerations involved fell to Mr. C. R. Pendock, of Derby, the Government Inspector of Factories for the district. The investigation was also attended by the Town Clerk of Ilkeston (Mr. Sidney F. James); the Gas Engineer and Manager (Mr. F. C. Humphrys); Mr. F. G. Robinson, on behalf of the deceased girl's employer; Mr. F. E. Smith, from Messrs. Pinsent and Co., Solicitors, Birmingham, for the makers of the holder, Messrs. C. & W. Walker; and Mr. J. E. T. Ducker, of Messrs. Moody and Woolley's, Solicitors, Derby, for the Royal Insurance Company.

PRELIMINARY EVIDENCE.

George Bostock, the occupant of the grocer's shop where the fatality occurred, gave particulars as to the drowning of the girl. He deposed that at about half-past one on the 8th inst. he was standing at the back door of his premises in Rutland Street, immediately contiguous to the gas-works, when he saw a great blaze on the south side, which was nearest his door. The flames spread out from the gas-works and rose very high. There was only a slight explosion perceptible. Rushing into the house for safety, he, with his wife, two children, and the deceased, descended to the cellar. Water then began to rush into the house. They retreated from the cellar, which became rapidly filled up to the ceiling; but the girl was unable to get out. He went into the water twice to find her, but was unsuccessful. The body was recovered about 25 minutes later, and attempts were made to restore respiration; but they proved abortive.

In reply to Mr. PENDOCK, witness said the flames appeared to envelope the whole of the gas-works yard, and came right up to the door of his house, which was about 45 yards distant from the scene of the explosion. He heard a rumbling, but not a ripping noise. The flames seemed to shoot up twice as high as the holder; the whole yard appearing to be in a flood of light. The back door of his house was removed either by the force of the explosion or carried away by the water. He had not previous to the explosion noticed any particularly strong odour of gas. They smelt the purifiers at times; but not that morning. He did not notice whether the conveying machinery was at work prior to the explosion.

In answer to a JUROR, witness said the water which came into the house smelt offensively. The rush of water was very rapid; the cellar filling in a second or two.

MR. HUMPHRYS' EVIDENCE.

Mr. *F. C. Humphrys*, for many years Manager of the works, produced a plan and explained that the diameter of the tank of the large holder which was destroyed was 115 feet, and its depth 26 feet, consisting of six rings. The first ring of the bottom plates was 5-16ths of an inch in thickness, and the others a quarter of an inch. The bottom was bound to the sides by angle iron, measuring 5 by 5½ inches; the side plates were 9-16ths of an inch at the bottom, decreasing by 1-16th to ¼ inch at the top. The holder was spirally-guided and composed of two lifts. The top or inner lift was 108 feet in diameter, 25 ft. 6 in. deep, and the bottom lift 110 ft. 6 in. and 25 ft. 6 in. deep. The capacity of the holder was 453,000 cubic feet. The tank rested upon the ground on a foundation of brick and concrete; the concrete being composed of one part of pure Portland cement to one-sixth of broken brick, or other hard material, and one of sand. The tank was held down by its own weight. The holder was put into use on April 30, 1909. He had had no occasion whatever to find fault with its construction. The holder was last inspected about a month before the accident. He then found there was nothing whatever wrong with it, and nothing had been reported to him since. He was in close proximity to the holder about one o'clock on the day of the accident, and it then appeared to be working quite satisfactorily. On the day in question, there was a strong wind blowing from the south-east, towards the point where the fracture occurred. He went home to dinner at ten minutes past one, and everything was then all right at the works. He was called back at 1.40, and then found that No. 3 holder was wrecked and that No. 2 holder was on fire. The fire was coming out on one side of the holder. The first thing done was to get the fire out of No. 2 holder. Afterwards they went into the damaged holder and found the air there quite breathable, although it was charged with gas. He had since the accident endeavoured to find out the cause.

The TOWN CLERK: Will you please tell the Court what, in your opinion, was the cause.

Witness: It seems very evident that there was a temporary locking of the outer lift of the descending holder.

The outer lift?—Yes. The inner lift, owing to the gas being drawn off through the mains to supply the town, would settle down. The inner lift would descend naturally until it became unsealed at the cup. The holder would come down, and the gas would escape.

The CORONER: You mean that the descent of the lift would press the gas through the water?

Witness: It would bring the water-lute down below the place where it was sealed, if it was jammed in any way.

Drawings were at this point produced and explained by the witness for the information of the Jury; Mr. Humphrys saying that an escape of gas from the outer lift caused by the unsealing allowed the inner lift to go down with a run, setting up a further shock to the tank through the guide-carriage. This shock, coming on top of the strain originally put on to the tank by the locking of the outer lift, caused a fracture of the tank, thus allowing the water to escape, probably not in great volume at first, but sufficient to cause the holder to break loose from its guide and to be carried by the water flowing from the gap into the gap itself. Then the strength of the tank being reduced by the fracture of the circle forming it, and the holder coming with its weight against the fractured place and, in addition, preventing the water escaping as freely as it would have done, provided the additional strain necessary to rip the tank from the bottom plates almost three parts of its circumference. The gas which escaped from the outer lift had by this time become an explosive mixture in the atmosphere, and was evidently fired by contact with a naked light, causing the huge flame described by the eye-witnesses. The condition of the top of the inner lift proved that there was no explosion in the holder itself, inasmuch as there was evidence of intense heat on the outside of the crown sheets, but no fracture. The nearest point to the holder at which there was a naked light was in the retort-house; but there was no evidence of fire in the retort-house itself. The retort-house was about 100 yards away from the point of which he had been speaking. Probably the nearest light would be a domestic fire in a dwelling-house near.

The TOWN CLERK: How long do you think there would have been this admixture of air and gas going on to cause the explosion?

Witness: The whole thing would take place in a few minutes.

A JUROR: That proves that the gas had a greater velocity than the wind at the moment?—Yes.

The JUROR: The wind was travelling in the contrary direction according to Mr. Humphrys.

Replying to questions by the CORONER, witness said the tank held about a million and a quarter gallons of water. It was not filled and tested when it was originally constructed. There had been no leakage whatever from the water-tank. No locking of the lifts had previously occurred, and it was difficult to explain why it happened in this case.

The CORONER: You suggest that as the holder sank down, it caused this huge volume of water to force the tank wall out?—Yes.

In reply to long series of questions asked by Mr. PENDOCK (eliciting at one point an observation from the Coroner that they had better not occupy too much time in going into theories), witness said the nearest point at which there was any electrical machinery from the place at which the fire occurred was 120 feet. There was there a coal conveyor worked by an electric motor. The motor was at the time of the accident, and had since been, in working condition. It was working at the time of the explosion.

Mr. PENDOCK: Would friction of metal against metal caused by the locking be likely to lead to a sparking?—I think not. It would not be at all likely to do so because they are well oiled and greased.

Have you ever taken particular notice of the action of these spiral holders in a high wind?—Yes. They are steadier. If a high gale came on, I would rather work with this holder than the two other column holders.

Based upon your experience, you would prefer the spiral holder as a safer apparatus?—Certainly.

Do you think that the wind had any effect in causing the locking in this case?—I have no reason to suppose so. It is, however, one of the causes to be taken into account.

The wind was in the precise direction, I take it, in which the escape of gas first took place?—Yes.

From your examination of the spiral guides and the spirals themselves, is there any evidence of hard jamming?—No.

It is mainly conjecture?—Exactly; there is no direct evidence.

Have you had any experience of spiral holders apart from this one?—It is the only one we have at work. I know what other people have. Before this was put into operation we saw a good many.

Are there any others at work in Derbyshire?—Yes, close to, very near here—at Long Eaton, Langley Mill, and Belper.

As a matter of fact, are they considered the very latest type of gas-holders?—Yes.

Because of the general satisfaction they give, and the safety of their working?—That is so.

I take it then you do not know any safer kind of holder?—No.

This was adopted as the safest?—After study of the subject and investigation, this was adopted as the best.

Mr. PENDOCK: My object in being here is to see whether this kind of thing can be prevented in future. What seems to have caused the most havoc is the ripping of the wall of the tank. Do you consider, as a matter of fact, in the light of this happening, that the wall of the tank was sufficiently strong?—I should say so. It was considered sufficiently strong according to the size of the holder.

It would be sufficiently strong to withstand the easy, steady strain of the load; but do you think it was sufficiently strong really to withstand sudden impact at one particular point?—It has shown it was not.

Do you think if the wall of the tank had been reinforced at the top (for instance, with angle iron plates of considerable strength), it would have been possible for the rupture to have taken place?—That would be very difficult to say. I think any reasonable addition would not have made a great deal of difference.

You think it would have to be particularly strong and exeeedingly strong to avoid it?—Unusually so.

Have you known any gasholder of any make to jam in this way before?—I don't think I have.

So that your theory is not based on any previous experience?—No, it is simply based upon observations of what took place here.

What caused the firing of the second or middle holder?—The coal-truck which was standing on the siding turned over and cannoned against the holder.

The CORONER: The coal-truck then was thrown against the second holder and caused the fracture?—Yes.

Replying to further questions by Mr. Pendock, Mr. Humphrys said that supposing the holder was filled to its utmost capacity, it would not entail a strain at any particular point. The holder had constantly been filled to its utmost capacity. There would be no pressure developed inside which would be too great for the strength of the metal. The holder was about two-thirds full at the time of the accident. There would be naturally a considerable drain upon the holder at this time of the year. Gas was supplied from the holder for power as well as illuminating purposes. The plates of the tank were of steel.

Mr. PENDOCK: After the accident you examined the plates, did you?—Yes.

Did you find there any evidence of any fracture of old standing?—Nothing at all.

They all appeared to be quite fresh?—Yes.

Was there anything to indicate at all whether the fracture began from the top when it descended?—Nothing to show that.

In reply to the District Inspector of Factories, witness further explained that the fracture was as nearly as possible perpendicular. There were no stays used to strengthen the attachment of the wall of the tank to the bottom. It would not be possible to have anything of the sort, either inside or outside. It was merely an angular connection all the way round. He had examined the holder at the point at which it came down upon the ground and was "dinged" on one side, and he had observed that the spiral ring was bent underneath the holder; but there was no sign of any fracture. Under the strain it did not appear to have given way.

Mr. PENDOCK: That is an indication to your mind that it was of correct material?—It must have been to have stood it.

Do you think the dinge was caused by the descent on to the ground?—Possibly where it struck the top of the wall.

That was not caused by the locking of which you speak?—No. In coming down that was caused.

In answer to Mr. Ducker, Mr. Humphrys further explained that, of the three holders on the works, the one destroyed was the only one placed above ground. It was impossible to say what might have happened in this case if the tank of the holder had been below ground. The escape of gas from the holder caused the top lift of the holder to fall violently.

Mr. DUCKER: There would be no explosion then caused by the escape of gas?—It all depends on what you call an explosion. There would be no explosive mixture direct from the holder.

The gas would escape free, would it not?—Yes.

It was by the gas escaping, however, that the holder fell?—Yes.

And the holder would have fallen whether the gas afterwards became ignited or not?—Yes

Do you agree with that?—Oh yes. The escape of gas allowed the holder to fall.

Therefore the ignition of the gas had nothing to do with the breaking of the tank?—I won't go as far as to say that. I think the fact of the gas escaping and becoming ignited had a great deal to do with the disaster.

Answering further questions by Mr. Pendock, the witness added that naturally when the gas became ignited, there would be a great increase of heat, and this would have a tendency to increase the volume of the gas inside the holder. That would, as a consequence, increase the pressure or velocity. The heat of one holder would cause the gas to expand in the other, and expand to its utmost capacity.

A JUROR: Were you satisfied that this tank was put up to proper thickness, and that it was in accordance with specifications?—Every plate was measured, and I am sure the work was correctly done.

In answer to other queries by members of the Jury, the witness repeated that when he left the works soon after one o'clock on the day of the fatality, everything then appeared to be safe. The reason why the holder was erected on the particular plan explained in this case was because of the fear of it being undermined in a colliery district like Ilkeston. If it had been placed underground, additional risk would thereby have been incurred. There were 16 degrees of frost on the morning of the explosion, but the water in the tank was not covered with ice.

A JUROR: I suppose there have been far more severe frosts and they never affected the tank?—No.

In answer to a further question by Mr. Pendock, witness explained that the height of the water-level would be 25 feet.

George Herbert, the Yard Foreman at the works, related his experience of having to save himself from the sudden onrush of water by scrambling on to the top of one of the coke heaps. The flame was then shooting above the holder which was destroyed. For a time the water rushed out in great quantities. Asked how long the fire lasted, witness said it blazed a bit and was quickly over. He went and stopped the engine to prevent any further gas getting into the holder.

George Beckwith, labourer, who was working in the sheds at the gas-works, said he first heard a rumbling noise coming from the direction of the big holder. He saw a flash, and the yard became lighted up by a big, red light. He looked round to see what the cause was. He saw a large flash which came from the top of the holder and lasted only a few seconds. Then he felt the rush of water. He and the other man were practically thrown down by the force of water, and they had to get out as best they could. He did not see the tank give way.

Mr. PENDOCK: Was the coal which was being used exceedingly dusty?—We were using from stock. It was not particularly dusty; not more than usual. It had been in stock some time under cover.

Coal under cover for some time is liable to ignition, is it not?—Yes.

Did you see anything in the coal-shed in the way of an explosion?—No.

Everything you saw came from the yard towards you—not from you towards the yard?—Yes.

Mr. Samuel Glover's Explanation.

Mr. *Samuel Glover*, M Inst.C.E., Engineer and Manager of the St. Helens Corporation Gas-Works, examined by the Town Clerk, said he had had considerable experience regarding damaged holders. At St. Helens, there were two holders which were damaged by an explosion of chlorate of potash at chemical works adjoining, with the result that one holder utterly collapsed and the other was much damaged; firing of the gas being caused by burning timber which got ignited through the explosion. He had also been called into consultation by the Cork Gas Company to advise as to an injury caused by outside influence. For forty years he had had experience of gasholders and their construction. He had carefully studied the construction of spiral holders, and in his opinion they were very suitable for some places under some circumstances. He had studied the drawings which had in this case been produced in relation to the holder that was wrecked.

The Town Clerk: What conclusion have you come to with regard to the holder?—That it was well designed and carefully constructed in accordance with the specifications and drawings submitted.

The Coroner: And in your opinion it was properly adapted to the requirements?—Yes, taking into consideration its cost.

Was it sufficiently strong for the work it had to do?—Yes.

If through economical regard for the amount to be spent upon it, it was badly built, it would not be satisfactorily constructed?—No.

You do not mean to imply, Mr. Glover, that enough money had not been spent upon it?—Not on this.

In reply to further questions by the Town Clerk, witness said he was called in by the Corporation to advise as to the cause of the accident, and visited the works about nine o'clock on the morning following the occurrence. He had been over to Ilkeston several times since; and as a result of examination he had been able to form some opinion as to the cause of the damage.

The Town Clerk: Is your opinion on the matter the same as that which has already been expressed by Mr. Humphrys?—Yes.

By the aid of miniature models representing the gasholder and tank, witness then proceeded practically to illustrate the way in which the gasholder rose and fell, adding that on the day of the accident, though the holder had previously been working steadily for years, something extraordinary must have happened. There was evidence of the tank smashing-up, the holder collapsing, and of fire occurring. One of the guides breaking would cause an additional strain to be placed on the holder. Something out of the ordinary way happened to the outer holder, and with the gas continuing to escape the inner holder would come into action before its time. That was, the inner holder would take up the duty of supplying the town with gas until, as Mr. Humphrys had said, the inner holder had lowered itself so far within the outer one as to unseal the cup, and then the inner holder would plunge into the outer lift. If one of the spirals became gripped, the inner holder would plunge on in the same direction—causing an unusual strain on the tank, and destroying it from existing as a tank. Then the holder would be set loose and would flow in the direction of the gap. The water would be prevented from flowing out in the ordinary way, and some ripping of the tank would follow. The gas which escaped from the two lifts then became lighted. It would diffuse into the atmosphere and burn with explosive force, the top of the holder showing effects of burning; the structure as a gasholder being damaged from the escape of gas which took place and the explosion that followed. Having expanded the gas inside, the holder went, in the manner which had been explained by Mr. Humphrys, and as was proved also by the experience of eye witnesses. One witness had said he saw the yard filled with flame. This resulted from the mixture of the gas with air outside the holder, burning all round and leading, from the causes explained, to the ultimate destruction of the tank.

The Coroner: I take it that the locking of one of these spirals caused the accident?

Witness: We have evidence that there had been considerable changes of temperature. Whereas the holder might work all right in one temperature or another, it might not adjust itself to a sudden change of temperature and work quite suitably. The tank would have to stand the extra strain in addition to holding the water, and the lift would sink quickly. The water poured across the yard in a big wave.

The Coroner: It would be quite sufficient to cause the disaster?—Yes. The water was free from the top to the bottom of the tank and was flowing across the yard.

May we take it that the death of this girl was caused by the bursting of the tank due to the accidental locking of one of the spirals?—Yes; and the wave of water would be rendered the more poisonous through it being impregnated with gas.

Was there an explosion?—Not inside the holder. The explosive mixture was provided outside. The gas must have been set free to provide it.

Do you think the lighting of the gas caused the bursting of the tank?—It added to the strain on the tank. It expanded the inner lift. The holder is damaged by explosion and heat. The tank is damaged by an accumulation of causes.

By explosion, heat, and pressure?—Or, taking it in another way, by pressure, explosion, and heat.

By Mr. Pendock: In case of unequal temperatures to which you have referred, does it mean that it would lead to unequal expansion. If a cold morning were followed by a warm midday, would that mean there would be expansion of gas in the body of the holder?—Yes.

So that differences of temperature would more rapidly affect the holder on the part containing the gas?—Yes; it would be very much more likely to affect the part of the holder containing the gas.

If in the course of the day the temperature rose considerably, the two upper lifts containing the gas would expand with some degree of rapidity?—Yes.

Would the water-tank expand with the same degree of rapidity?—Certainly not. Gasholders spirally guided are provided in some measure with means for meeting unequal expansion and contraction.

Is there a special allowance made for the unequal expansion?—Yes; by movement upon the spindles of the guide-rollers.

Do you consider that in this case there was due allowance made?—I have no knowledge that there was not. It is an important point. There was an allowance—that is all I can say. It would not be possible to tell after the accident.

The Coroner: It is a mathematical problem?

Witness: It is a case in which you would have to use the highest mathematics. You would want to allow the proper factor of safety.

By Mr. Pendock: The pressure on the walls of the tank was 13 lbs. per square inch.

Would not 25 feet of water give a higher pressure than that?—I have not calculated it absolutely. You will find it rather less than 13 lbs. per square inch.

The gas must have taken fire in some way?—Yes, there is ample evidence of that.

How far away do you think, taking the radius from the centre of the gasholder, it would be possible to fire a mixture of gas and air?—It would depend on the density of the atmosphere and the rate of diffusion. First, it had to get free from the gasholder. It would be more explosive at a point further away from the gasholder than as gas itself. It would travel when it got lighted with very great rapidity in proportion to the excellence of the explosive mixture.

There would be rings all round the tank of explosive mixture which would increase in bulk?—Yes.

What would be the diminishing point?—It would be impossible to say. The whole of the circumstances would have to be taken into account. It would be impossible to say at what point the gas diffusing into the atmosphere would form the most explosive mixture. It would be quite possible for it to reach a source of light.

You think it is quite a feasible explanation that the outer rings of the explosive mixture got as far as the fires in the dwelling-house?—It would take a little time, of course. You have the sequence of events established right through by the evidence. This leakage had been going on for a little time without any one knowing. The strain on the gasholder had been continuing for some time; there was the diffusion of gas and the lighting.

Would these explosive rings account for the flames spreading over the whole yard?—Yes.

The Coroner: Once lighted, it must go on?—Very quickly; it would go on to the central source of the gas.

Mr. Pendock: Can you tell us definitely, for the information of the Jury, that the explosion could not have happened inside the holder?

Witness: It is impossible to explode pure coal gas. It is impossible to burn it except in the presence of atmospheric air or oxygen. One could go upon a holder when it was full of gas, make a hole in the crown, and light the jet of gas without harm. There was no impetus to drive out the gas from the inner lift, as it was driven out, except the great heat outside. There was breathable atmosphere inside the inner lift of the holder when Mr. Humphrys entered, though the crown was not torn open or burnt through; for after the gas had burnt itself out, and the ironwork cooled down, cold air would enter, and provide the breathable atmosphere Mr. Humphrys found when he went under to shut the valve above which the holder had settled.

Have you had experience of coal gas being fired by friction?—Yes.

Can it be caused by friction of one metal against another? Can you explode gas by a pick driven against metal?—It has been done.

The Coroner (to Mr. Pendock): I do not want to have all this theory.

Mr. Pendock, continuing his examination, asked the witness: From your investigation have you formed any opinion whether this accident would have happened, the bursting of the water-tank could have been caused, if the escape of gas had not been fired?—I think the escaped gas being fired added to the strain on the tank, and was one of the incidents in the matter.

The Coroner: A combination of the circumstances—the locking of the spiral and the firing of the gas which caused the other thing?—Yes. If the holder became unsealed, it would set free a large volume of gas into the atmosphere. That would add to the strain and the contents of the tank as a tank.

In answer to further questions, Mr. Glover said it had been clearly proved that on the day of the accident there was a strong wind, and this would have to be taken into consideration. But they had had in Ilkeston experience of stronger winds than existed on this particular day, and the holder had stood.

By Mr. Ducker, representing the Royal Insurance Company: You made a report to the Corporation a few days ago in which you say it is quite clear there was no explosion of gas inside any of the gasholders. Mr. Pendock put a question as to possible ignition through two metals coming into contact, but you say there was water there, and adhere, as I understand it, to the opinion expressed in your report that there was no explosion in the gasholder itself?—Yes. When I speak of the gasholder I am speaking of the gasholder, not the tank—only the holder as a holder. The gasholder is a gasholder; the tank is quite a different thing. I should like to make it quite clear, therefore, that when I speak of a gasholder I mean the floating body, which is a gasholder, and I do not in that association include the tank.

That is the body floating in this 1¾ million gallons of water?—Yes.

You say in your report also that it is improbable there was any explosion of gas at all?—Accurately speaking, you cannot explode gas. You must have an explosive mixture of gas and air.

The report goes on to say that after the firing of the gas the gas burnt itself out and caused the holder to settle?—That is really what happened; and I repeat what I said that there was no explosion in the holder itself. The gas burned outside.

I take it that you endorse the theory stated by Mr. Humphrys as to the cause?—It is a fact that such holders have locked and do lock occasionally under extraordinary circumstances. Scientific men are always looking for the truth in regard to possible causes.

The locking, I take it, might have led to the escape of gas?—It might do. It did do in this case.

Was it not the escape of gas which let down the top holder?—The fact that the gas could get out led the top holder to descend quickly.

Quite apart from what happened to the gas when it escaped, you mean the fact that it had escaped from the holder let the top of the holder down rapidly?—Yes.

The holder being let down rapidly caused the fracture which resulted in the breaking of the tank?—I think it was one of the factors. I

do not attribute all the damage we had here to the explosive burning of the gas and air outside the holder.

Do you feel able to suggest to the Jury how important a part the ignition of the gas played in the havoc. The escape of gas let down the holder, and it in turn breaks some of the stays and fractures the tank?—I said this was a contributing factor.

That happens through the escape of the gas. How much importance do you attach to the part played subsequently by the ignition of the gas which escaped?—I could not apportion that. I say it contributed to it.

Do you think that the tank would have burst if the gas that escaped had not ignited? If you do not feel able to say that do not?—I do not feel able to say. We must admit that it was a contributing factor. But in what proportion we cannot say; and it would be wrong on my part to speculate. You must remember that the tank had stood for some years, and there must have been a great disturbance to bring about the disaster which has occurred.

Replying to the TOWN CLERK, Mr. Glover said that in this case there was no explosion in the ordinary sense of the word. There was very little resistance except from the atmosphere.

MR. J. FERGUSON BELL'S EVIDENCE.

Mr. *J. Ferguson Bell*, M.Inst.C.E., the Engineer and Manager of the Derby Gas Company's works, said he had had professional experience extending over thirty years as to gas-works, and had recently erected two steel gasholder tanks, one at the Burton Corporation Gas-Works and another at the Belper Gas-Works. The latter was a three-lift spiral gasholder, very similar to the one to which the accident had happened at Ilkeston. Steel tanks for gasholders had of late years come very largely into use, with increasing favour—in fact, out of every hundred gasholders erected, at least eighty had steel tanks. He had listened carefully to Mr. Glover's evidence, and concurred generally with the conclusions at which Mr. Glover had arrived. He was of opinion that the initial cause of the accident was the locking of the spiral arrangement. Something occurred which led to the upper lift coming down. This would cause the breaking of the seal, with the result that large volumes of gas would be immediately released. The gas, mingled with air, would form an explosive mixture, and by some means it ignited. The tank was ripped open; the water pouring out in huge volumes, and causing the damage described.

The CORONER: Do you think that the tank burst first, or was it the explosion which caused the tank to burst?—I would not like to state that definitely. It occurred probably almost simultaneously. There was a certain downward pressure from the explosion, which would occasion the damage and strain to the tank.

You are satisfied that the quality of the steel was sound?—Yes. I ascertained the working test regarding this steel. I should have no hesitation in passing the plates as good, sound plates. I have carefully examined the holder which descended, and the workmanship of the holder, and it was, in my opinion, of excellent workmanship and in accordance with the specification and drawing exhibited.

Can you give any idea as to the cause of the damage?—That is impossible to say. I have known gasholders come down in unaccountable ways.

It would occur very suddenly?—Yes, very quickly.

By Mr. PENDOCK: Do you know of any other steel tanks of the actual capacity exposed above ground like this one?—Yes.

Are they working quite satisfactorily?—Quite.

The only place in which the metal itself could resist the flow of the water would be the shearing strength?—Yes.

Do you think that the shearing strength was in this case sufficient?—The margin is between three and four on the tensile strength. There was a pressure of 1625 lbs. to the square foot at the bottom of the plate. He had calculated the bursting strain on each ring of tank plates, and the strength of the tank. Instead of giving the figures, the diagram he had prepared would more clearly indicate the results. On one side of a vertical line, the part coloured blue showed the bursting pressure, and on the other side of the vertical line, the part coloured pink indicated the strength of the tank plates.

Do you think, as a practical engineer, the strengthening of the top edge of the tank would be a safeguard against any accident of this kind happening again?—Yes.

Supposing the tank gave way first, without any reference to any jamming of the bottom lift, could that have had the same results as we are discussing?—It is hard to believe. The disaster followed rapidly and then the flow of the water.

There was less risk really from the tank first bursting than from the gasholders themselves jamming and allowing the gas to escape?—I think so. It depends on how quickly the water got away.

If the water had been allowed to flow slowly, as from a tap, there might not have been the same result? Witness acquiesced.

[Next week we propose to publish drawings of the spiral-guided gasholder and steel tank, with diagrams of strains, along with tests of the steel tank plates put in evidence by Mr. Bell. These will no doubt interest our readers, and tend to elucidate any points incompletely dealt with in the evidence before the Coroner, who naturally did not desire to go too much into purely technical matters.—ED. J.G.L.]

VERDICT.

The Jury returned a verdict, agreeing with the Coroner's estimate of the case, that the death of the girl Gough was caused through the inrush of water occasioned by the jamming of one of the spirals of the gasholders and the consequent mishap.

Ebbw Vale Water Supply.—A Local Government Board inquiry has been held at Ebbw Vale into an application by the District Council for sanction to borrow £43,658, to pay off excess expenditure on the water-works, and for extending the adit, purchasing land, and laying new mains. Sir Alexander Binnie and Mr. W. Binnie (Consulting Engineers) explained the proposals, to which there was no opposition.

SOUTH SUBURBAN GAS COMPANY.

Half-Yearly Report and Accounts—The Proposed Amalgamations.

The following is the report of the Directors of this Company for the half year ended the 31st of December, which will be presented at the ordinary general meeting on Friday.

The accounts show that, after providing for the debenture interest and including the amount brought forward from last half year, the balance available for dividend is £35,418 10s. 6d.; and the Directors recommend payment of dividends at the rate of 5 per cent. per annum on the 5 per cent. preference stock, and at the rate of £5 16s. 8d. per cent. per annum on the ordinary stock—this being 3s. 4d. per cent. more than the last dividend, consequent upon the reduction of 1d. per 1000 cubic feet in the price of gas as from July last. The amount to be carried forward to next half year will be £16,272 13s. 10d.

The labour troubles of the last few months have seriously interfered with the due fulfilment of coal contracts. Anxiety on this account has not abated. But, in the midst of almost general unrest, it is gratifying to be able to record that, under the influence of the system of co-partnership, the loyalty and goodwill of all grades of the Company's employees remain unquestioned. It is, in the opinion of the Directors, to the active exercise of this loyalty and goodwill that much of the continued success of the undertaking is due.

There has been a satisfactory increase in the sales of gas of 5·57 per cent., of which 3·89 per cent. is due to the special installations of high-pressure gas lighting and large-sized gas-engines at the Crystal Palace. Arrangements have been made for the use of these engines to be continued during the ensuing season, when it is expected that the high-pressure lighting, which formed a very attractive feature of last year's exhibition, will also be resumed.

Prices for residuals have been fully maintained during the half year, at the end of which, however, there was a slight falling-off in the value of coke. The sales department has been kept exceptionally busy by the continued demand for gas fires, cookers, and various heating and also lighting appliances. An additional show-room has been opened at Forest Hill.

Agreements have been entered into with the Bromley and Crays and the West Kent Gas Companies for acquiring their undertakings; and these will be submitted for the approval of the proprietors, as also, at a special meeting of which notice has been given, a Bill for carrying them into effect, and for other purposes. The Directors believe that the proposed amalgamation will be in the best interests of the consumers, and consequently of the proprietors, of all three Companies.

It is with the greatest regret that the Directors have to record the death of their esteemed colleague Mr. Robert Morton, who had rendered most valuable services to the Company as a Director for twelve years, during seven of which he was Deputy-Chairman. He also served as Chairman for a short time on the death of Sir George Livesey. It is not proposed for the present to fill up the vacancy thus created, having regard to the provision in the Bill now before Parliament for the appointment of a temporary Director.

One Director (Mr. Jabez Light) and one Auditor (Mr. Samuel Wood, F.C.A.) retire from office at this meeting, and, being eligible, offer themselves for re-election. Mr. George Ross, the retiring Employee-Director, has been re-elected without opposition.

The accounts accompanying the report show that the total expenditure on capital account at the close of the half year (including a nominal amount of £202,500 added by conversion) was £790,471, or £40,892 less than the receipts, inclusive of £49,305 premium capital—£831,363 in all. Only £482 was expended on capital account in the half year. The revenue from the sale of gas was £84,053; the rental of meters and stoves produced £7510; the sale of residuals, £37,348; and the total receipts were £129,024. The following were the principal items of expenditure: Manufacture of gas (including £45,650 for coal and £13,312 for maintenance of works and plant), £65,368; distribution, £22,128; management, £5646; rents, rates, and taxes (£5716); and miscellaneous items bringing up the total to £104,909. Among these items is a sum of £2000 charged on account of the co-partnership scheme. The balance carried to the net revenue account is £24,115; and the amount applicable for dividend, £35,418.

The statements as to working show that, under the supervision of Mr. S. Y. Shoubridge, the Engineer, 64,700 tons of coal were carbonized in the half year. The quantity of gas made was 788,188,000 cubic feet, of which 723,022,000 cubic feet were sold and 732,170,000 cubic feet accounted for. The residuals were: Coke, 776,400 cwt., of which 126,930 cwt. (estimated) were used in manufacture; breeze, 15,250 yards; tar, 591,686 gallons; ammoniacal liquor, 19,320 butts—the make of sulphate of ammonia being 746 tons.

London County Council and Cottage Lighting.—At the meeting of the London County Council last Tuesday, the report of the Housing of the Working Classes Committee on the subject of the lighting of the cottages on the Old Oak Estate [see *ante*, p. 234] was adopted.

Lighting of Kensington Infirmary and Workhouse.—The Kensington Guardians have received a letter from the Controller of the Gas Sales Department of the Gaslight and Coke Company (Mr. F. W. Goodenough) in regard to the contemplated substitution of electric light in the Infirmary, at a cost of £2000, with an estimated annual expenditure of £525 for current and lamp renewals. He submits that by the installation of the most modern and efficient gas-burners the Company can guarantee to give for £325 a year fully as much light, for the same number of hours per annum, as could be obtained from the latest pattern electric lamps for £525 a year, taking current at 2½d. per unit; and that the cost for the installation would not exceed £500, instead of the £2000 required for electric light. He further stated that the Company would be prepared to fit up a portion of the Infirmary with new burners on trial for a month at their own cost and risk, and also to submit proposals for reducing the cost of lighting in the Workhouse.

COMPLIMENTARY DINNER TO MR. W. B. M'LUSKY.

Eulogies and Good Wishes from Colleagues and Friends.

Mr. W. B. M'Lusky, who, as readers of the "JOURNAL" are aware, has obtained the appointment of Gas Engineer and Manager to the Halifax Corporation, was last Friday entertained at a complimentary dinner, in the Station Hotel, Perth, by a representative gathering of his colleagues in the gas profession and other friends, prior to his departure from the Fair City, where he has held the position of Gas Engineer and Manager for the past eleven years. Lord Provost MACNAB presided; and among others present were Provost M'Farlan, of Dumbarton; Councillor Clark, Convener of the Gas Committee of the Perth Corporation; Lieut.-Col. Peebles, Edinburgh; Mr. D. Macfie, Mr. J. R. Milne, Mr. A. Mackenzie, and Mr. Joseph Hepworth, of Edinburgh; Mr. J. Barker, Leven; Mr. R. Watson, Secretary of the Coupar Angus Gas Company; Mr. J. H. Kemp, Harrogate; Mr. W. A. Duff, Newcastle-on-Tyne; Mr. J. G. Abbott, Huddersfield; Mr. A. Yuill and Mr. J. Mitchell, Dundee; Mr. S. Milne, Aberdeen; Mr. G. R. Hislop, Paisley; Mr. George Keillor, Broughty Ferry; Mr. A. Waddell, Dunfermline; Mr. A. Mackay, Montrose; Mr. P. B. Watson, Wishaw; Mr. J. Dickson, Forfar; Mr. Allan Reid, Brechin; Mr. A. Smith, Tradeston, Glasgow; Mr. J. B. Scott, Cowdenbeath; Mr. A. C. Young, Arbroath; Mr. W. Ewing, Lochgelly; Mr. W. Peattie, Dunblane; Mr. W. Blair, Helensburgh; Mr. J. W. Napier, Alloa; Mr. J. F. Black, Newport; Mr. S. G. M'Lusky, Coupar Angus; Mr. J. Barker, Nairn; Mr. J. Napier Myers, Saltcoats; Mr. D. Robertson, Dunoon; Mr. James Purves, Ayr; Mr. John Lang, Alexandria; Mr. J. Gibb, Newton-on-Ayr; Mr. S. B. Langlands, Lighting Inspector, Glasgow; and Mr. R. S. Johnstone, Gas Engineer's Office, Dundee.

The usual loyal and patriotic toasts having been duly honoured,

Mr. YUILL (the Hon. Secretary) mentioned that apologies for absence had been received from a large number of gentlemen connected with the gas industry all over the kingdom, as well as from many personal friends of Mr. M'Lusky, all of whom testified to the many excellent qualifications of the "guest of the evening."

Provost M'FARLAN proposed "The Imperial Forces," to which Lieut.-Col. PEEBLES responded.

Lord Provost MACNAB, in proposing "Our Guest," said he was sure it was with pleasure that they were all assembled to join in the honour being done to Mr. M'Lusky. He was also sure that there was no other public official—indeed, no public man—in Perth who could draw together so large a gathering. There were gentlemen present from all parts—from London in the south to Inverness in the north. That large and representative meeting was a striking and unique testimony to the popularity and position of Mr. M'Lusky. There could not have been that meeting unless he had been well known and much respected in the gas industry. In speaking to the toast, he ought at once to say that the Town Council of Perth regretted very much losing the services of Mr. M'Lusky, into whose career he thought it unnecessary to enter at length. He had passed almost from being an apprentice to becoming a gas engineer and manager, which was a testimony to his youthful ability, to power to work, and to that natural and acquired ability which had developed with the passing of time. Still a young man, Mr. M'Lusky had been a gas manager and engineer for twenty years. First at Kirkcudbright, then at Kelso, afterwards in Selkirk, and for the past eleven years in their own city. Now he was to be Engineer and Manager of the Corporation Gas-Works at Halifax. Mr. M'Lusky's promotion in his profession had thus been rapid and progressive; and, best of all, it had been merited. His rise, however, had been punctuated by one or two stops. He just failed to obtain some appointments for which he applied. But "there's a divinity that shapes our ends, rough-hew them how we will." It was an experience common to all of them that they sometimes missed what they aimed at. Mr. M'Lusky had had a little experience of this kind. But it was also evidence that the disappointment of to-day was often followed by the success of to-morrow, and then the success was all the sweeter. He thought it only necessary to give a few details of Mr. M'Lusky's efficient, careful, and successful management of the gas-works in Perth. Since his appointment, the gross profits of the undertaking had increased from £5300 to £14,400 per annum, while the capital debt of the undertaking—though, of course, the total in itself was greater than it was eleven years ago—had been reduced from £1101 to £806 per million cubic feet of gas sold. The quantity of gas unaccounted for last year was only 3·2 per cent., which was below the average; while the amount of gas sold per ton of coal carbonized was 10,731 cubic feet, which was far above the average for Scotch coal. The wages paid in Perth per 1000 cubic feet of gas sold were higher than those paid in Edinburgh, Glasgow, and Dundee; while the net cost of gas delivered into the holders was lower than in any of these places. The sale of gas had, of course, largely developed under Mr. M'Lusky's management. Ten years ago, the quantity sold was 159 million cubic feet; while last year it was 234 millions. The yearly sale of residual products had also shown a very marked increase, having risen from £3654 in 1901 to upwards of £9000 last year. Above all, the price of gas for all purposes had been considerably reduced. In the case of ordinary consumers, it had been brought down from 3s. 6d. per 1000 cubic feet, which was the price when Mr. M'Lusky took over the management, to 2s. 9d.; representing a saving to the consumers of about £9000 annually. All this was, perhaps, not to be wondered at. He would give the reason, which was taken from the opinion of Mr. Newbigging: "There is no rule-of-thumb working at the Perth Gas-Works. I have but rarely in my experience seen a gas-works conducted on more scientific principles, or more economically and well." The gas-works themselves were thoroughly up-to-date, and were indeed model works; and this was mainly the work of Mr. M'Lusky, by whom the present coal and coke plant and the residual products works were all designed and carried out. The facts and figures he had given, and more which he might give, afforded the very best evidence of Mr. M'Lusky's energy, ability, and devotion to duty. Again, the relations between him and the employees under him had always been of the happiest character. He was a good judge of an assistant, and a master who was liked by his men. Needless to say his good work and the splendid results obtained had been recognized and appreciated by the Council and the citizens. Bailie Watson, who was then Convener of the Gas Committee, wrote of Mr. M'Lusky not long after he (the Lord Provost) had entered the Council: "Nothing is too trivial for him to examine, nor too great for him to overcome. He revels in his work; and his promotion to a higher and more important sphere of labour is only a question of time." And now that this promotion had come, he (the speaker) felt, in common with all the members of the Council, that they and the citizens had lost a most valued public servant. He did not anticipate that the climax of Mr. M'Lusky's upward career would be at Halifax. One of the leaders of his profession, he ventured to think that Mr. M'Lusky would later on mount the professional ladder higher; and whatever position he attained he would certainly adorn. Apart altogether from Mr. M'Lusky's unvarying success in the different appointments he had held, he had made a name for himself in connection with Scottish Gas Associations, wherein he had done yeoman service. While in the Border towns, their guest, on becoming President, put new life into the venerable, but at one time moribund, Waverley Association of Gas Managers. He had been prominently identified with the work of the North British Association of Gas Managers, of which he was President in 1906; while his contributions (both in papers and discussions) had been many and varied, and always of value. Writing of the address which he delivered as President, the "JOURNAL OF GAS LIGHTING" said:

> It was to be anticipated that the President would give an address which would be conspicuous for its applicability to the advanced thought of the times. That expectation was fully realized. Mr. M'Lusky clearly has the faculty of taking a view of gas matters which in the political world would be characterized as statesmanlike, which, in other words, means that his vision is not obscured by the gate of his own works. Nor, indeed, by the horizon within which are grouped the present-day public questions relating to the gas industry. His mental view extends far beyond these; and his utterances are valued by his brethren for the element of guidance which they find in them.

Mr. M'Lusky's uncontrolled management for some years past of what was known as the Informal Meeting of Gas Managers in Glasgow had given the liveliest satisfaction to his brethren, who would sorely miss him in their discussions wherever they might meet. Altogether, in his addresses and in his general work on behalf of the Scottish Gas Associations, he had established himself as one of their first bench men. He had not been the spoilt child of fortune, nor had he been a favoured son of the goddess of chance. He himself, and no other, had been the builder of his own reputation and the maker of his own fortune. He (the Lord Provost) would only add further that outside business Mr. M'Lusky's personal character and qualities were of the best, and in keeping with his sterling character as a workman. On behalf of his colleagues in the Council, for himself, in their name and in the name of absent friends and well-wishers, he wished Mr. M'Lusky continued good health, continuing prosperity, success in his new appointment, and still further advancement in his profession. He asked all present to join with him in pledging most heartily the toast of "Our Guest."

The toast was pledged with enthusiam and with musical honours.

Mr. M'LUSKY, who had a hearty reception on rising to reply, said he had to thank his Lordship for his kind remarks and his all too generous statements. He felt when his Lordship was speaking that human character was made up of good and ill, and that all human effort and achievement was composed of good and bad; and the Lord Provost that night had served them with all the good he (the speaker) had ever done, and left out all the bad. He thanked his friends and fellow-citizens and his professional brethren from a distance for the hearty reception they had given him. He took it as a great compliment that they should have come at much personal inconvenience to give him such a hearty send-off. He saw round the table friends who were with him when he came to Perth—friends who were identified with his coming, because to obtain an appointment of the importance of the gas managership of Perth, one must have friends in advance. It would be mere affectation on his part to say he got the appointment out of merit alone, because he knew that anything he had done in the way of making or distributing gas, or any other achievement that had come to him, might have been first of all due to his poor effort, but it was most of all due to the good friends who had surrounded him. He was glad to see present men who were with him at the beginning of his service, and who had been with him throughout and encouraged him, who had represented always the very best that was in him, and had consistently displayed the good and kept the bad in the background. Now that he was leaving Perth, it was only due to the Town Council to say that, notwithstanding all the immovable mass they might have placed against the irresistible force—[laughter]—they never questioned his ability to manage the gas-works, and they never denied him anything he wanted—ultimately. He had found the Council a very formidable body, but always a very fair-minded body; and he would not give them for any other Town Council of which he had ever had experience. The Gas Committee had always supported him; but the Council had not always supported the Committee. The Committee had always known their business; and the Council had always thought they knew it. Eventually, however, the Committee, by sheer devotion to duty, and with a little educational influence, obtained everything that was in the best interests of the community; and the result was that to-day every member of the Council, and he believed every citizen who interested himself in the gas undertaking, was agreed that very few mistakes had been made. At the present time, the Council were possessed of gas-works which were the most important revenue-producing undertaking they had, and the most valuable property within the city. When the works were in course of construction, they were ironically stigmatized as the Klondyke, on account of the large amount of money sunk. To-day the citizens realized that the gas undertaking was a Klondyke indeed. He was now going to another sphere; and he felt that he was leaving many friends behind him. He also felt that there was no prize to be gained without sacrifice; and while he recognized the sacrifice he was making in leaving so many good friends in Perth, he also recognized, as was said to him that evening, that "he was still under the same flag." He was not going abroad; he was only crossing the Border. In the gas industry there was no boundary to their territory. The German gas engineer and the Scottish gas

engineer were colleagues in the same industry, with the same end in view; and the intercourse between them and the Continent was one of the most valuable things they had in connection with the gas profession. He had a note of a little motto he saw in the plumber's shop of ex-Bailie Watson when he came to Perth: "Dae it and be dune wi' it. Trust in God and do the right." He would just add a motto he had adopted throughout his career: "Never despair." He thanked them for the great honour they had done him. [Applause.]

Councillor CLARK, Convener of the Gas Committee of the Perth Corporation, in giving "The Gas Industry," said it went without saying that the industry was one of the most important in the country. Having given a number of statistics to show its progress, the speaker remarked that at the present time a good deal was heard about smoke abatement, and public health authorities advocating a clearer atmosphere. In this direction, as well as in that of the tar-spraying of roads, he said the gas industry was a very important instrument in the development of the public health movement. They could not say, however, that gas at the present day had not its rival—a very formidable rival—in electricity; and they had also another prospective formidable one in the shape of proposed legislation in connection with what was termed "daylight saving." Electricity was undoubtedly to be reckoned with; and yet he thought there was less dread of it that day as a rival to gas than there was when it was first introduced. At that time certain gas shares were standing at £4, whereas to-day they stood at £30 or £40. This showed that the public confidence, so far as the investing part was concerned, was fully restored in respect of gas as an illuminating power for the future. The increase in the output of gas was proved very conclusively by the results of even the past ten years, as compared with the previous similar period. In the United Kingdom it was 28 per cent.; in Scotland, 25 per cent.; and in Perth, 30 per cent. During the past thirty years, there had also been a very solid decrease in the price of gas. It had been reduced from 4s. and 5s. per 1000 cubic feet to half this figure, and even less. One of the principal causes of this had been the advent of the incandescent burner, by which they were getting four or five times more light for the same consumption of gas; and on this account gas had become much more popular. Another cause had been the working-up of the residual products. He noticed that in Perth for the past year the coal bill amounted to £11,000, while the receipts from residuals were £9000, which brought the net cost of the coal down to something like 2½d. per 1000 cubic feet of gas. Were it not for the fact that they had this great revenue from residuals, he believed gas would be 10d. per 1000 feet dearer than at present. He was of opinion that in every municipality there was ample room for both gas and electricity. Where a corporation held both monopolies, common sense and prudence should dictate a policy of friendly rivalry as opposed to one of wasteful and cut-throat competition. Both systems could work very well together. Where electricity was in the hands of a large supply company opposed to the corporation, gas would in many cases have a stiff battle to fight; but the genius of manufacturers and inventors, as in the case of gas mantles and all sorts of appliances, had up to now kept gas well to the front. For heating purposes, it would hold the field for many years to come. The speaker proceeded to give statistics in connection with the gas supply of Perth, and said he considered the present position of the Gas Department was largely due to the skill and conscientious services of Mr. M'Lusky. As Convener of the Gas Committee, he wished to say he never wanted to have under him any better official than Mr. M'Lusky had been. He thought it was due to him and to his brethren in the same profession that the gas industry stood in the position it now occupied; and he did not think they need have the least anxiety as to what the future would be.

Mr. S. MILNE, President of the North British Association of Gas Managers, in reply, said the gas industry comprised upwards of 800 undertakings in the United Kingdom, employing a capital of 135 million sterling, carbonizing 15,400,000 tons of coal annually, and producing 199,000 million cubic feet of gas, which was distributed through 36,122 miles of mains to 6,418,000 consumers and 721,000 public lamps. He gave an outline of the progress made by the industry since the days of Murdoch, and referred to the introduction of the Welsbach burner as having given it a new lease of life for lighting, and had placed it in a very firm position for combating their formidable competitor the electric light. This was making a strong bid for supremacy; but it must still take second place in the matter of lighting, and was "not in it" as a heating and cooking agent. While the development of lighting had gone on apace, the application of gas for purposes of cooking and heating had made very rapid progress indeed; and the field for its further development was still very wide. Competition had been the life of the gas industry; and while it was making greater and greater demands upon the resourcefulness and ingenuity of those in charge of the administration of its undertakings, there were fortunately men in the ranks of the gas profession who were prepared to devote themselves heart and soul to its furtherance, and by indisputable evidence would refute the assertion of those who said the days of gas for lighting had almost expired, while those for heating and cooking would in the course of a few years have to succumb to the inroads of electricity. Before concluding Mr. Milne bore testimony to the high ability and sterling character of the guest of the evening.

The other toasts were "The Town and Trade of Perth," proposed by Mr. J. HEPWORTH, and replied to by ex-Bailie MACPHERSON; "The Hon. Secretary," proposed by Mr. J. W. NAPIER; "The Chairman," by Mr. D. MACFIE; and "The Croupiers," by Mr. D. ROBERTSON.

The company was rich in musical and elocutionary talent; and a successful and enjoyable evening was brought to a close with the singing of "Auld Lang Syne."

The Southcoates and Alexandra Ward ratepayers have been discussing the question of the price and quality of the gas supplied by the East Hull Gas Company. Mr. Phillips said complaints had been general with regard to the unsatisfactory conditions; and he suggested sending a strong protest to the Company, asking them to furnish gas of higher illuminating power, and expressing the opinion that the time had arrived when there should be a reduction in price. The meeting agreed that this should be done.

MUNICIPAL EMPLOYEES AND THEIR DEMANDS.

Strike at Stalybridge—The Town in Darkness.

We learn from our Manchester Correspondent that the unrest which has been manifest for some considerable time among the Lancashire members of the Municipal Employees' Association is assuming a serious aspect. During the past week, it found vent at Rochdale and Stalybridge in a strike; and an *ultimatum* has been sent to the Oldham Corporation that the men will be brought out at the end of a fortnight unless in the meantime their alleged grievances are remedied. The strike at Rochdale only affected one department—that of the Sanitary Committee; and a very few days sufficed to bring about a collapse of the movement, with the men clamouring for their jobs back again—a request which could not be complied with, as most of the vacant places had been filled. The position at Stalybridge was different. There three departments were involved—gas, sanitary, and highways; and the strike was only brought to an end on the Town Council giving an undertaking that a number of tramwaymen who left work in sympathy with the strikers should be reinstated at once, besides promising that on Thursday next representatives of the Corporation will meet a deputation of the men concerned in the dispute, and that whatever advances in wages may be made, such increases shall date as from the 29th inst. By the withdrawal of the gas workers at Stalybridge, the town was in darkness for two nights during the strike, and great loss was necessarily caused to employers of labour generally and their servants, because on three days the mills and workshops could only be run from daylight to dark—the places depending upon gas power having to shut-down altogether.

Recently the members of the Municipal Employees' Association in Stalybridge made efforts to force the hands of the several Committees of the Corporation on the question of a minimum weekly wage of 25s. and on other demands. These were under consideration by different Sub-Committees; but the men apparently grew impatient at the delay, with the result that on the night of Sunday, the 21st inst., the employees at the gas-works and those connected with the highways and sanitary departments decided to stop work—the number concerned being about 160, of whom 80 were gas workers. The latter did not return to work, and the manufacture of gas could not be continued. The lamplighters who joined in the strike refused to turn out the lights in the streets on the Monday morning; and this duty had to be performed by the officials, who also acted as lamplighters in the evening of that day. There was not much gas in the holders, mainly owing to the heavy demands made on the department of late by reason of the short and foggy days. About ten o'clock on Tuesday night, the supply of gas was exhausted, and the town was plunged into darkness. On the morning of that day, the men had resumed work on a promise being made that their demands would have immediate attention; but after a few hours they all left again because six tramwaymen who struck work with them had not been reinstated. The Mayor (Alderman Ridyard), who is Chairman of the Gas Committee, and had given the undertaking to the men's leaders as to their demands being considered immediately by the Council, was out of town; so that nothing definite could be done in the way of a settlement pending his return. What added to the difficulty was the fact that the tramwaymen were not really the servants of the Corporation, but of a Joint Board representing other towns besides Stalybridge. Late on Wednesday night, a settlement was arrived at, and the men resumed work on Thursday morning; but it was not until Friday that the mills and workshops fully resumed work, and sufficient gas was passing through the mains to allow of ordinary illumination.

The loss in wages to the cotton and other operatives by the curtailment of the working hours on the three days is estimated at between £1000 and £1500. The town, as indicated, was in darkness on the Tuesday and Wednesday nights; and great inconvenience was caused to shopkeepers and the inhabitants. Naturally there was a brisk demand for candles, lamps, and oil; stocks being quickly cleared out by local traders at considerably enhanced prices.

By the terms of settlement, Mr. J. T. Jones, of Manchester, as a representative of the Employees' Association, undertakes to support the Stalybridge Town Council in any action they may take in punishing workmen guilty of defying the officials. He believes that, as the result of next Thursday's conference, terms will be arranged which will satisfy the men.

At a meeting of the Joint Tramways and Electricity Board on Thursday night, a letter was read from Mr. Jones, in which he said: "I desire to tender to you an apology for the withdrawal of certain of your Committee's employees, and take this opportunity of thanking you for the reinstatement of these men, while also tendering you their regret." The apology was accepted.

Threats of a Strike at Oldham.

The municipal employees at Oldham have decided to strike work unless their demands in regard to wages and holidays are dealt with by the several Committees of the Corporation within a fortnight. In a letter to the Town Clerk of Oldham, Mr. J. T. Jones, of Manchester, the local Secretary of the Municipal Employees' Association, states that the members of the Oldham branch are indignant at the way in which their application for increased wages has been treated by the Town Council; and he adds: "Unless the whole of the recent applications, including the establishment of a minimum wage of 25s. a week, and a corresponding advance to carters, be reopened and discussed within fourteen days, serious consideration will be given to a general cessation of work." The members of the Association include gas workers and the employees in the water-works department.

At a meeting of the Water-Works Committee on Thursday evening, a copy of the men's resolution was brought forward for consideration. The Town Clerk stated that last year two applications were made for a week's holiday with pay, and for an advance of 2s. per week. In the course of the discussion, Alderman Wilde said he did not object to the holiday, but was not in favour of granting it with pay. He pointed out that at the local mills and workshops the employees had a week's holiday, but they were not paid for it; and he argued that the Council

ought not to concede the demand of the men, as they were the trustees of the ratepayers. It was decided that the Mayor should be asked to convene a special meeting of the Town Council to consider the matter.

The Position at Southport.

Presiding at the first annual social gathering of the Southport branch of the Municipal Employees' Association, held last Wednesday evening at the Temperance Institute, the Mayor of the Borough (Mr. F. T. Reynolds) said that the men employed by the Corporation, when comparing their conditions and pay with other workers outside, should remember that there were many workers in the town who had not the advantage of regular employment—an inevitable result of the seasonal nature of many trades in such a town being that work was often intermittent. To the municipal employees, the average weekly wage during the year should be the test. If the subject was regarded in this way, the Corporation employees would be seen to be the better off. The Mayor added that he did not point out this fact to suggest that municipal workers should be content with things as they were. Certain matters raised by the Municipal Employees' Association were under consideration; and he could assure the men that sympathetic attention was being given to the demands put forward. His advice to the men was to "hasten slowly," and not be impatient.

GAS CONSUMPTION IN EDINBURGH.

Investigations into the Cause of its Decrease.

It may be remembered that about the middle of November last the Gas Commissioners of the Edinburgh and Leith Corporations remitted to Mr. W. R. Herring (the Consulting Engineer), Mr. A. Masterton (the Acting Engineer), and Mr. A. Canning Williams (the Treasurer and Collector) to consider and report upon, separately and independently, the position of the gas undertaking, as disclosed by the accounts of the Commissioners during the past few years, particularly in regard to the falling off in consumption and revenue, and to offer suggestions as to the means by which an increased use of gas might be obtained, and as to how the financial position of the undertaking might be improved. Mr. Herring has made his report, and, with those of the other two gentlemen named, it came before the Commissioners at their meeting yesterday. We give below some extracts from Mr. Herring's report; leaving till next week the other reports, together with notes of the discussion to which their presentation gave rise.

The business of the gas undertaking has not in recent years shown that elasticity which formerly prevailed, as can be seen by studying the figures of output year by year. It is perhaps a safer basis to compare period by period; thus equalizing exceptional years and circumstances. From 1889, when the Commissioners came into existence, to 1911, the gas output increased 66 per cent. By breaking this term into five-year periods, we have the following scale of increases for each five years: 1891 to 1895, 19·6 per cent.; 1896 to 1900, 26·2 per cent.; 1901 to 1905, 6·3 per cent.; 1906 to 1910, 5·9 per cent. The output is therefore shown to have fallen away from an average of 5 per cent. per annum increase prior to 1900, to but a little more than 1 per cent. per annum up to 1910. In 1911, less gas was sold than in 1907.

The causes which have led to this stagnation in the output are numerous, and in some respects are common to all undertakings. The improvements in the methods of burning gas for lighting purposes have resulted in great economy to the consumer. The loss due to this economy, however, in the case of some undertakings, has been recovered by a more vigorous commercial policy in placing in consumers' hands every appliance by means of which gas can be used for domestic and trade purposes at the lowest possible cost. In doing this, however, trouble has arisen locally with tradesmen, who claim to be the vendors of such appliances; they considering that their interests are adversely affected by what is termed "municipal trading." Whether, having embarked in the trade of making and supplying gas to a community, it is right to hesitate to supply the appliances by means of which the gas can be used to advantage, is a point for the Commissioners to consider seriously; and circumstances do seem to indicate that something of this kind must be done if the undertaking is to continue to prosper, and the consumers saved from an increased cost in the price of gas due to the present oncosts being distributed over a smaller output. There is also every reason to anticipate that the cost of the materials used, and the labour involved in its manufacture, are likely to increase.

[Mr. Herring gives particulars as to the facilities offered to the public in respect of the supply of cookers and other appliances, whether on hire or sale.]

As the circumstances that have brought about the reduced consumption are to a great extent permanent, as instanced by the fact that the gas consumption in the public lamps and stair-lights is less by 52 million cubic feet per annum than was the case five years ago, notwithstanding the fact that the number of stair-lights has increased from 15,000 to upwards of 17,000 and the public lamps by a few hundreds, it seems urgent that some additional facilities should be offered the public to induce them to take advantages of the economy and cleanly use to which gas can be applied in domestic and trade purposes to a far greater extent than is at present the case in the Commissioners' area of supply.

For some years past, record has been kept of the hourly output of gas day by day; and, on looking over a summary of this data, it is clearly shown that the loss of consumption has taken place during what may be termed "the lighting hours"—that is, from sunset to ten o'clock. It may also be interesting to note that the consumption between ten and twelve is greater than it used to be; indicating that the public are keeping later hours than was formerly the case. The loss that has taken place during the lighting hours has been approximately made up during what may be termed "daylight hours;" and this is particularly notable during the hours when it may be suggested meals are being prepared.

The principal factors that have adversely affected the gas output during the past ten years are, among others, the following: The universal adoption of the incandescent system of burning gas in both private and public lighting. The competition of electricity, which has resulted in the loss of large consumers, and which, with the metallic filament lamp, is likely to become keener even than in the past. Atmospherical conditions, which, for several years past, have been in favour of the consumer. The winters have been particularly mild and open in their character, and what is still more remarkable is the extraordinary recurrence of bright afternoons, though the day may open dull and cloudy. For several winters past, the afternoons have cleared, and thus avoided the use of artificial light at an earlier hour. An extra hour's darkness on a winter's afternoon represents a consumption of from three-fourths to nearly a million cubic feet of gas.

The economies resulting from the causes enumerated have, to a large extent, been equalized by the enlistment of a large number of new consumers, as we find that in 1901 there was a total of 80,405 consumers, whereas in 1911 there were 95,570. The population during this period in the area of supply increased only 2·84 per cent., whereas the consumers increased 18·8 per cent. In fact, it is only by this increase in the number of smaller consumers that the output has been maintained during the past decade. In 1901, there were 3975 uninhabited houses, shops, offices. &c.; whereas in 1910 there were 8714 such premises—an increase of 4739.

At the present time, the gas consumers, divided into the population in the gas-supply area, are equal to one consumer for each 4½ persons. This seems to indicate that the district is, so to speak, saturated, and that there is little scope left to obtain new consumers at the present day. The average consumption per consumer has, in the last decade, fallen from 21,424 to 19,831 cubic feet; this alone increasing the oncosts in the administration of the distributory and clerical departments outside of the manufacturing station.

There is, in my view, a great possibility of increasing the use of gas for domestic and industrial purposes, if some means can be devised whereby the consumer can become possessed of the necessary appliances for its economical use without bearing the first cost of its installation; and I will proceed to show how much more profitable this will be than even the attachment of new consumers to the system.

During the year 1911, 2s. 8d. per 1000 cubic feet was the actual average price received for the entire gas sold; and the following table will show how this sum is made up, and the various purposes for which sums are required to meet expenditure.

[Mr. Herring gives a statement showing in detail how the price charged for gas is appropriated per 1000 cubic feet of gas sold; the figures being for the year ended May 15, 1911. The net cost of gas is put at 1s. 5·32d.; and the capital and sinking-fund charges came to 1s. 1·94d.—making together 2s. 7·26d. The revenue from gas (less discounts) was 2s. 7·99d.; and the balance, 0·73d., was carried to the revenue account.]

The statement shows that the entire cost for manufacturing gas at the Granton works, including the purchase of all materials, payment of all wages (including clerical and technical staff), and a moiety of the Engineers', &c., salaries, the repair, replacement, and upkeep of the plant and all materials used in conjunction therewith, is 9·99d., or (say) 10d. per 1000 cubic feet of gas sold. Seeing that some portion of this is represented by management, technical and clerical staff wages, &c., an increased output, up to a considerable limit, could be dealt with without increasing the works charges—to the extent, in my view, of a saving of 1d. per 1000 cubic feet.

Dealing next with the distribution of the gas, which includes the wages of the meter readers, repair and replacement of mains and service pipes, meters, stoves, &c., gas-fitters, district inspectors, and from which is deducted the income derived from the rental of appliances and profit on trading transactions, the net amount under this heading is 1·81d. per 1000 cubic feet of gas sold. Any increase in the consumption of gas, by the present consumers in particular, would not incur any additional expense in this department. The increased quantity passing through the same pipes and meters, and being attended to by the same staff, would involve no extra wear and tear, and, at the most, would require the substitution of larger for existing small meters.

The cost of installing additional appliances would be a capital charge, to be covered by the rentals on the appliances, or otherwise met out of the saving that would result from an increase in the consumption through the present sources of supply. As, however, there might be some incidental expenditure under this heading, I would prefer to estimate a saving of 1·5d. per 1000 cubic feet of gas, which would leave an additional sum of £2500 per annum to meet the contingencies referred to. Similar remarks apply equally to the next group, comprising the Treasurer's Department—salaries of collectors, rental clerks, &c.—as this staff would be merely engaged in entering up a different set of figures representing a larger consumption of gas to the present consumers. Under this heading we therefore have an economy of 1·16d.

Under the heading of general establishment charges, Imperial and local taxation, pensions, superannuation, &c., there is a total cost of 4·36d. There is no reason to anticipate that any of these figures will be increased as the consequence of selling more gas to the same consumers, unless it were the item of bad debts and some additional stationery. I therefore propose to leave an additional sum of £2500 a year to be spent under this heading, that might be incurred, which leaves a clear saving of 4d. per 1000 cubic feet.

The next group is the capital charges, interest on annuities, and money borrowed, contributions to the sinking fund and special reserve fund, amounting in all to 1s. 1·94d. The only item in this group that would be increased through the output of a larger quantity of gas would be the tax of 2d. per 1000 cubic feet, which was imposed upon the Commissioners in their 1908 Order as a special contribution to the liquidation of the debt on the old works.

These figures amount in all to 1s. 6·6d.—say, in round figures, 1s. 6d.—per 1000 cubic feet of gas sold, and at present incurred under the headings enumerated, which would not recur on any additional quantity of gas sent out to the present consumers, as the structural capacity of the works at Granton is sufficient to supply the increased

quantity of gas. The distributory system is equally capable of dealing with an increased sale, as is also the clerical and technical staff in all departments.

There is another aspect of the question which goes to confirm these views, and that is that the field open for development, in the use of gas for domestic and industrial purposes, largely takes gas during daylight hours. If, therefore, some scheme can be inaugurated whereby a greater consumption among present consumers can be fostered, it will have the effect of reducing the costs to all consumers alike; whereas the present tendency of decreasing output threatens to increase the cost to all consumers alike, as the oncosts already referred to require to be paid whether the consumption remains stationary or becomes less, and it is only by fostering a greater consumption that there is any possibility of reducing the price of gas below its present figure. On the contrary, I fear that the trend of events is likely to increase the manufacturing costs, as not only coal but other materials, while constantly fluctuating in value, never seem to drop back to the original low level from which they rise.

In my view, the only effective way of fostering an increased consumption among the present consumers and others is to supply them with the appliances necessary for using it. By the arrangements enumerated earlier in the report, some progress has undoubtedly been made in this respect; but the necessity of running the hiring business on a paying basis, independent of its influence on the undertaking as a whole, has necessitated rentals being charged which do not seem to encourage the use of gas to the extent that it can profitably be applied by the consumer. Our own experience, and that in other towns, has proved that there are few (if any) who are willing to purchase appliances for its use.

It therefore seems that the Gas Commissioners, as trustees of the gas consumers' interests alone, must be prepared to adopt any reasonable means that can be shown to further the well-being of the undertaking; and as they are in a position to purchase all such appliances at the lowest possible cost, they are likewise in a position to place these in the hands of their consumers at a similarly low price, as their object is not to make a trading profit, but to supply their consumers with gas at the lowest possible cost.

The logical sequence to the municipalization of the gas supply, coupled with the circumstances now prevailing (which could not possibly be foreseen at the time of the purchase of the undertaking)—primarily the internal economies brought about by the improved methods of lighting, and secondarily the keen competition of electrical supply by municipal departments, and the great bid that is now being made for the introduction of electric heating, &c.—seem to compel the adoption of some such proposals as I have made.

It will, however, be well to consider to what extent the private trading interest will be affected. From inquiries I have made from the principal manufacturers of gas appliances other than for lighting, I am told that the volume of business transacted with the ordinary trader is meagre in the extreme. If such is the case, then the trader is not losing much by the adoption of the forward policy foreshadowed. It must further be considered that, in carrying out such a policy, the Commissioners would be wise to put some limitation on the class of goods offered—such, for instance, as the adoption of certain types of moderate cost, leaving the better-class trade still to be done by the private trader with the individual who can afford to pay for good taste as well as utility.

In this respect, I think it is admitted without question that the Commissioners already have the field for gas-cooking and similar domestic appliances exclusively within their purview, but that the rates fixed for the hire of them are such as to have limited their general adoption. While several instances could be given where these appliances are offered free of rental, and fixed free to the consumers, such a practice may involve heavy capital outlay without having any corresponding advantages to the finances of the undertaking; and while the supply of such appliances to the consumers free will, no doubt, be duly considered by the Commissioners, personally I am of opinion that a low-rental basis—say, 5 per cent. per annum on the cost of the stove, including fixing, &c.—will not, in my view, retard the adoption of such appliances by *bonâ-fide* users.

So far as heating appliances are concerned, up to the present the Commissioners have made no serious advance. It is in this respect that I would suggest that, in the first instance, the Commissioners should adopt the policy foreshadowed, and determine upon a certain type of moderately-priced heating-stoves, and either sell these outright on a minimum cost basis, on the hire-purchase system, or let them out, fixed free, on a low-rental basis. I am inclined to suggest that such a policy, instead of injuring the trader's interest, would have a tendency to further his interests, as there would be a large number of people who would be disposed to buy a better-class stove than what the Commissioners might be prepared to offer on the special terms; and, furthermore, the ironmongers would have a field open for the sale of culinary articles, which would go far to improve their accounts with people whom they now serve.

Then, again, so far as the trade of gas-fitters and pipe-layers is concerned, this would undoubtedly be benefited by such a policy. If the Commissioners were to adopt the practice of engaging the trader skilled in the work to carry out the fixing of the stoves in the consumers' houses on a priced schedule basis, and subject to the supervision of the Commissioners' officials, the consumers' interests would be fully safeguarded by having the skilled experience of the Commissioners' officials supervising the fixing of the stoves and the laying of the piping, and the trader would get his ordinary profit in carrying out the work.

With regard to the supply of appliances for industrial purposes, there is nobody more qualified than the Commissioners to cater for this market. Not only are their servants versed in the use of such appliances, and kept in touch with the latest developments that are going on, but they are able to supervise the economical use of such appliances in the interest of the trader.

There is another aspect of this question which is important. It will tend to the elimination of the smoke nuisance where gas is used instead of solid fuel; and, furthermore, it will encourage the smaller industries in the locality, provided the right type of apparatus is introduced, and its proper and economical use is constantly supervised by skilled hands. It therefore seems to me that such appliances should fall within the Commissioners' purview for sale at the lowest possible price.

There yet remains to be considered the lighting problem. This is a much more complicated factor, and will necessarily affect a very much larger trading interest than any of the others previously dealt with. Personally, I am of opinion that the little skill required in the fixing of incandescent burners has now been acquired by all who supply them; and its advantages are so apparent as to need little (if any) assistance at the hands of the Commissioners.

The fitting-up of lighting installations in factories, churches, schools, and other large institutions is another matter. Here, I think, the Commissioners should retain a free hand to propound schemes, and (if necessary) carry them out. Hitherto this has been done on the basis of charging a fair trade profit, so that while the Commissioners have at times given quotations for lighting installations, these have been based on a scale that would enable any competent tradesman to compete; and, furthermore, the practice has been followed of offering skilled supervision free to consumers who prefer to place their work in the hands of the private trader.

At the present time, it is possible to introduce lighting installations under the high-pressure system in factories, workshops, and large institutions; and as these require skilled supervision and special appliances, in my view the Commissioners are the best authorities to deal with this business, which should be introduced on the same principle of a bare trading profit on the cost of installation.

GLASGOW CORPORATION AND GAS-COOKING APPLIANCES.

It was recorded in the "Notes from Scotland" in the "JOURNAL" for the 16th inst. that the Corporation of Glasgow had, by a substantial majority, decided to supply, free of charge, gas appliances to be used for domestic purposes. The recommendation of the Gas Committee which resulted in this decision was the outcome of inquiries made by a Sub-Committee in various towns in which the free supply of gas-stoves, &c., is in operation; the particulars obtained being embodied in a full report, accompanied by tables and charts. Some extracts from it, showing how Glasgow stood in this matter in comparison with certain of the places referred to, and justifying the Committee's recommendation, may not be without interest.

The Glasgow Corporation commenced to let out gas-cookers on hire in 1885; and though at first the progress was slow, the number of consumers supplied has increased rapidly in recent years. From 1885 to 1901, the number of appliances on hire rose to 21,053; and from 1901 to 1911, the increase went up to 78,997. Figures furnished by the Sub-Committee in regard to Dundee, Manchester, and Paisley showed that the percentage increase of cookers and hot-plates since 1904 had been more rapid where these appliances were supplied free than in Glasgow, where a charge was made. The total percentage of consumers using gas cooking appliances at the end of the last financial year was as follows: Manchester, 47·3; Paisley, 44·7; Dundee, 43·5; Glasgow, 28·8. So that to bring Glasgow up to the same percentage as Manchester, 50,000 more consumers would require to be supplied with cooking appliances. A tabular statement in the report showed the relative figures for the gas manufactured from 1901 to 1911, with the total percentage increase since 1904, in which year the free supply of gas appliances was adopted in Manchester. The Sub-Committee pointed out that if Glasgow had maintained even the same percentage increase as Manchester, the output would have been at least 500 million cubic feet extra per annum—a quantity which they said would have reduced the standing charges by a sum equal to about 1d. per 1000 cubic feet. Another statement furnished details as to the capital and repairs charges; the latter item including the provision and fixing of grillers and small boiling-burners.

We extract the following figures for the first and last years of the period taken:—

	1901.	1911.
Total cookers and hot-plates on hire	£21,053 0 0	£56,493 0 0
Total added during the year	2,331 0 0	3,797 0 0
Amount added to capital do.	8,061 0 0	10,313 0 0
Total capital (less depreciation)	43,519 0 0	67,475 0 0
Capital per cooker or hot-plate	2 1 4	1 3 10
Cost of repairs*	5,082 0 0	14,825 0 0
Cost per stove	0 4 9	0 5 3
Total yearly revenue from stove hire	5,798 0 0	9,465 0 0
Average hire per stove or hot-plate	0 5 6	0 3 4

* This includes charges against stove-shops and rent, taxes, gas used, and all other outlays; also part of the clerical staff, and the provision and fixing of grillers and boiling-burners.

It will be noted that the capital standing against each cooker or hot-plate has been reduced from £2 1s. 4d. in 1901 to £1 3s. 10d. in 1911. It is explained that this result has been obtained through the liberal writing-down of capital in the name of depreciation. The yearly revenue from stove hires amounted last year to £9465, equal to 3s. 4d. per cooker or hot-plate. These hiring charges have been much reduced from the rates formerly charged; and this reduction, no doubt, accounts in some measure for the largely increased use of gas appliances during recent years. The sums received as hire do not represent the total returns to the department from the gas-cooker business, as the profit made on the gas used in these appliances must also be taken into account.

The Sub-Committee offered the following remarks: "The gas consumed for lighting purposes entails the heaviest charges on the department; and this may be easily explained. The large proportion of the gas used for lighting being taken during the winter months only, the staff, works, mains, meters, &c., must be provided to cope with the

period of heaviest demand. As soon as the days begin to lengthen, less gas is required for lighting purposes, and plant has to lie idle and unremunerative for varying periods until the next lighting season. All the standing and oncost charges are being fully incurred, even while the plant is out of use. The gas consumed in gas-engines and for manufacturing purposes, being taken in practically regular quantities throughout the year, can be supplied at less cost. The staff and plant, being regularly employed, can be kept at a constant strength, and no loss is incurred by lying idle or being only partly used. It is, therefore, possible to sell gas for power and manufacturing purposes at lower rates than gas for lighting; and this is provided for—the rates for power and manufacturing purposes being 1s. 6d. to 1s. 4d. per 1000 cubic feet, compared with 1s. 11d. to 1s. 8d. for lighting purposes. The gas sold for cooking purposes, being largely taken in the daytime and during the summer months, can be supplied at even less cost to the department than gas for power and manufacturing purposes. The plant and staff required in winter for the supply of gas for lighting can be utilized during the summer months without extra cost; and therefore the real cost to the department for the supply of gas for cooking is little over the bare manufacturing charges, as practically the whole cost of distributing plant, meters, oncost expenses, treasurer's departmental charges, and charges for interest, sinking fund, depreciation, &c., would still have to be met even if no gas were used through the cooking appliances. With a total of 79,000 cooking appliances in use, including nearly 57,000 on hire, the gas at present used for cooking purposes in the appliances on hire is certainly not less than 600 million cubic feet per annum. This quantity, taking the cost of supplying such gas at 11d. per 1000 cubic feet, leaves, with the present selling price, a profit to the department of (say) £30,000 per annum—a sum that will not only meet all charges which can properly be made against the cooker account, but will allow of a good balance to assist (leaving the present stove rentals out of consideration), in reducing the price of gas for other purposes."

The Sub-Committee said they had considered the matter mainly in the interest of the consumers and of the department; but remembering the comfort and saving in labour in the homes of the consumers where these appliances are used, and the immense improvement in the state of the atmosphere over the city which would inevitably result from their more general adoption, it appeared to them to be not only a matter of good business for the Gas Committee, but also one concerning the interests of the whole community, that everything possible should be done to encourage and extend the use of these appliances. The best method of doing this seemed to be, from the experience of other gas departments, to give out the appliances free on loan. They therefore recommended that the Corporation should supply gas appliances for domestic purposes free of charge as from the 1st of March; and, further, that, for the purpose of regulating and ensuring their proper use, they should be given out subject to the conditions attached to their report.

PUBLIC LIGHTING IN DUBLIN SUBURBS.

Figures for Rathmines.

In the "JOURNAL" a fortnight ago, some particulars were given in regard to the cost of gas and electric lighting in Dublin, as submitted to the Inspector (Mr. C. H. O'Conor) who is conducting an inquiry, on behalf of the Local Government Board for Ireland, into the question of the equalization of rates in Dublin and the neighbouring townships. In the course of the evidence of Mr. J. F. Pilditch for Rathmines and Rathgar, he stated that he had prepared tables showing the cost of lighting by gas and electricity. The average cost of each electric arc lamp was £16 4s.; and of each incandescent lamp, £4 6s. There were 108 arc lamps in the township, and they were used for lighting about four miles of roads. There were 495 incandescent lamps, used on about 13 miles of roads; and 356 gas-lamps, which cost about £3 1s. 10d. each. The total cost of public lighting in the township was £30,421 for the past five years, or an average of £6084 per annum. The cost of public lighting had been increased by 233 per cent. in recent years; while the increase in the city had only been 73 per cent. He did not think the price charged per lamp for electricity in Dublin was too high. The lighting of a city by electricity would cost a little more than by gas; but the light would be better. In reply to questions by Mr. Clancy, K.C. (for the Dublin Corporation), witness admitted that it was correct to say that the cost per arc electric lamp in Rathmines came to £21 5s. per annum, whereas the figure, worked out in the same way, for Dublin was £22 per lamp, though each Dublin lamp was in use for 1200 more hours per annum than the Rathmines lamps. In reply to questions by Mr. P. White, who also represented the Dublin Corporation, witness said they had no means in Rathmines of telling what kind of gas they were burning; but so long as they were getting satisfactory light they were contented. He never tested the lamps for candle power. If he was dissatisfied, the Gas Company always put them right. Asked by the Inspector how the gas lighting in Rathmines compared with that in Dublin—whether it was as good, better, or worse—witness said he could not give any opinion. He admitted that he had seen the gas lighting in Dublin, but he had not taken particular notice of it.

In the editorial article on "High-Pressure Gas for Street Lighting" in the last number of the "JOURNAL," it was remarked there appeared to be "a growing preference for this work for Mannesmann steel tubes;" and in the report of the Glasgow deputation it was mentioned that at Manchester these tubes might be used if further extensions were made. We learn that not only has Manchester adopted Mannesmann weldless steel spigot and faucet tubes, with rigid joints, but that these are already in use in Glasgow, as well as in Edinburgh, Belfast, Leeds, Cardiff, Newcastle-on-Tyne, Tottenham, Brentford, and other large centres, and also by the Gaslight and Coke and South Metropolitan Gas Companies, for high-pressure mains.

CANNOCK GAS PURCHASE QUESTION.

The Result of the Poll.

Meetings were held last week both for and against the proposed purchase by the Cannock Urban District Council of the undertaking of the Cannock, Hednesford, and District Gas Company; and the poll of the ratepayers fixed by the Council was taken on Saturday. The result was declared on Saturday night, as follows:

Against the purchase	1108
For " "	881
Majority against	227

There are 5649 voters on the register for the Cannock urban area, so that only about one-third of the electors took the trouble to poll.

COBHAM AND LEATHERHEAD GAS AMALGAMATION.

An Extraordinary Meeting of the Cobham Gas Company was held at Salisbury House, E.C., last Wednesday, for the purpose of approving a Bill "to enable the Leatherhead Gas and Lighting Company to acquire the undertaking of the Cobham Gas Company; to confirm the agreement entered into with the latter Company; and to authorize the raising of additional capital by, and the conferring of further powers upon, the Leatherhead Gas and Lighting Company." Mr. C. E. Woolnough presided. The Solicitor (Mr. W. T. W. Birts) read the terms of the offer of the Leatherhead Company, which were to take over the debenture stock at its face value (£5450), and the assets and liabilities as set forth in the balance-sheet to Dec. 31, 1910, or on such a date in 1911 as should be arranged for amalgamation (which date the Directors suggested should be March 31); and to give each shareholder who is willing to continue in the Company one £10 share in the Leatherhead Company (present value £10 10s.) and £2 bonus in cash for each four Cobham shares, making an equivalent of £3 2s. 6d. per Cobham share—fully 30 per cent. of its nominal value—or to those wishing to realize their holding, £2 10s. immediate cash for each Cobham share. The Chairman proposed a resolution in the terms indicated. Mr. H. Mitchell criticized the figures produced by the Leatherhead Company, and contended that the Cobham Company were not receiving sufficient for their undertaking. He said it seemed to him that they were getting rid of a very fine asset; and he submitted that the bargain should not be completed. The Chairman said he could quite sympathize with these remarks; but it was rather late in the day for the shareholders to consider what might have been. Mr. Mitchell had refrained from indicating how they could have done better or obtained a higher price. All the matters were discussed very fully when they decided to take the course they had done. Of course, it was at the option of any shareholder or proprietor to be in opposition, and to carry it to Parliament, where the matter would be finally decided. The resolution was carried by five to three. Mr. Mitchell demanded a poll. Mr. F. Hue Williams (a Director) formally moved that a poll be taken; and it was unanimously agreed to. Subsequently the Chairman announced that, subject to verification, the capital in favour of the resolution represented £12,500, and against it £2590. He declared the resolution carried; and the petition for the Bill was sealed.

An Extraordinary Meeting of the Shareholders of the Leatherhead Gas Company was held on Thursday evening, for the purpose of approving of the Bill, of which notice has been given to enable the Company to acquire the undertaking of the Cobham Gas Company; to confirm the agreement entered into with the latter Company; to authorize the raising of additional capital; and to confer further powers upon the Leatherhead Company. Mr. F. Hue Williams (Chairman of Directors) presided. The Secretary (Mr. J. Young) having read the title and preamble of the Bill, the Chairman moved that the seal of the Company be affixed thereto; and the motion was carried unanimously. The Chairman said the proprietors might probably like to know that the previous day the shareholders of the Cobham Gas Company, notwithstanding the reiteration of some fairy tales which had been refuted over and over again, approved of the Bill by an overwhelming majority. He might say that the amount of stock represented in favour of the Bill was £12,750, and £2450 against; while in the room there were 550 shares in favour of the Bill and 45 against. He therefore thought there was very little doubt that Parliament would give their sanction to the measure.

MUNICIPAL GAS PROFITS.

Salford's Amended Offer to the Outside Districts for a Compromise.

The Parliamentary Committee of the Salford Corporation are making another effort to effect a compromise with the authorities of Eccles, Worsley, Swinton, and Pendlebury on the question of gas profits, and so avoid the matter being fought out at Westminster. The offer, which is made entirely without prejudice, is that there shall be a limit of the amount to be applied in relief of rates from the gas undertaking; the Committee being willing to recommend the Council to fix this limit at £15,000, with an additional £2500 on the new capital of £250,000, or proportionately thereon. It is pointed out that this is less than 2 per cent. on the aggregate capital expenditure of the Corporation upon their gas undertaking; that the maximum amount per annum which the Corporation can apply in relief of rates will be £9000 per annum less than the average amount which they so applied for the ten years prior to 1909, when the Salford Bill was before Parliament; and that it will ensure that all the saving in the cost of manufacture of gas by the reduction of the illuminating power will go to the consumer.

Mr. L. C. Evans, the Town Clerk of Salford, in a letter conveying this offer to the Town Clerk of Eccles as representing the three authorities who have lodged a Bill with Parliament which aims at compelling

the Corporation to give effect to the decision of Lord Donoughmore's Committee in 1909 with reference to gas profits, and in the subsequent case of Glasgow, says: "The Committee direct me to say that the decision in the Glasgow case was based on a Scottish Act which does not permit profits to be made in relief of rates by the sale of gas, and is not applicable to England and Wales, where both law and practice for many years have recognized the application of gas surplus revenue in relief of rates to meet the constantly increasing financial burdens placed upon municipalities by Parliament. If, however, the Scottish law is to be adopted in England and Wales, the Committee's view is that it should be done, if at all, by a General Act of Parliament; so as to place all municipal trading concerns on an equal footing."

The outside authorities are reminded by Mr. Evans in the communication that the Electric Lighting Clauses Act, passed so recently as 1899, and which is applicable to all municipal electricity undertakings, including Eccles, of course, authorizes the application in relief of rates of 5 per cent. on the aggregate capital expenditure of an electricity undertaking, after payment of interest on capital, and payment into a sinking fund and to a reserve fund. "A Public General Act of this kind," he says, "is surely better evidence of the policy of Parliament than the decision of a Committee in the Salford case. The application of this decision to Eccles would seriously affect their electricity and tramways undertakings. The Eccles Corporation made a surplus revenue of £1054 from their electricity undertaking for the last financial year, after payment of interest and sinking fund, of which £964 was placed to reserve, and the balance applied in payment of capital expenditure. This sum of £1054 represents 2½ per cent. on the net debt of £42,598, and nearly 2 per cent. on the aggregate capital expenditure of Eccles on their electricity undertaking; whereas if the decision of the Lords Committee in the Salford case were applicable thereto, the amount placed to reserve would be £212, and £425 in relief of rates, and the price of electricity would be reduced to consumers, of whom the Salford Corporation is by far the best customer of Eccles—paying no less a sum than £3856, out of a total revenue of £8478 from all consumers. The Eccles Corporation made a profit of £2181 last year from their tramways undertaking, on an aggregate capital expenditure of £69,647, or slightly over 3 per cent. thereon. On the net debt of £57,650, this is nearly 4 per cent. The profit has been applied in paying the cost of street widenings and in accumulating a reserve fund, which now stands at £6506—being nearly 10 per cent. on the aggregate capital expenditure and nearly 12 per cent. on the net tramways debt of Eccles; whereas, on the contrary, the Salford Corporation have no power to accumulate a reserve fund for their gas undertaking. If the decision mentioned were applied to the Eccles tramways, this profit would have to be materially reduced; and, logically, the principle will have to be applied to Eccles if it is enforced upon Salford."

The Town Clerk adds: "The Committee consider that the Salford Corporation are entitled to a fair return upon the aggregate capital expended upon their gas undertaking, just as the Eccles Corporation are entitled to a fair return upon the aggregate capital expended upon the Eccles electricity undertaking. The Eccles Corporation are entitled by law to apply in relief of rates from that undertaking 5 per cent. upon the aggregate capital expended; but the Salford Corporation have never at any time claimed, nor ever, in fact, applied, so large an amount in relief of rates from the Salford gas undertaking. With the view, therefore, of meeting the contention of the outside authorities that there should be a limit of the amount to be applied in relief of rates from that undertaking, the Committee are prepared to advise the Council to fix a limit."

The Salford Parliamentary Committee offer to meet in conference a Sub-Committee representing the outside authorities, should there be any points arising out of the communication that require elucidation.

SECOND SMOKE ABATEMENT EXHIBITION IN GLASGOW.

Prospective Arrangements.

Readers of the "JOURNAL" may remember that in the summer of the year 1910 the Corporation of Glasgow decided that it would be most desirable to bring before the citizens and the inhabitants of the West of Scotland, in a practical and interesting fashion, the latest and most scientific devices in connection with smokeless heating and lighting, embracing every up-to-date method and contrivance for the complete combustion of solid fuel, as well as the most modern developments in heating, lighting, and ventilation by gas and electricity. Realizing that the readiest means of interesting the public in these matters would be to hold an exhibition, which would bring before them in a concrete form the advantages to be gained and the economies to be effected by the adoption of recent scientific discoveries, the Corporation entrusted to a Special Committee the organization of such an exhibition; and it was held in the Victoria Road Skating Rink from the 16th of September to the 8th of October, 1910. During this period, between 70,000 and 80,000 visitors from Glasgow and the district passed through the turnstiles—clearly showing the keen interest taken by the public in the question. Since the time of that exhibition, the Corporation have initiated a system of differential rating for electric energy, so that the charge for current for other than lighting purposes is 1d. per unit; and, as our readers are aware, they have also decided to supply free of charge gas cooking appliances for domestic use.

Having regard to the phenomenal success of the exhibition, and realizing that the two concessions just referred to cannot fail to promote in a most marked degree the use of both gas and electricity for domestic purposes and the employment of the necessary apparatus, the Corporation have decided to hold another exhibition from the 20th of September to the 12th of October next; and the prospectus has been issued. It will be held under the auspices of the Society of British Gas Industries, the British Electrical and Allied Manufacturers' Association, the Coal Smoke Abatement Society, the Smoke Abatement League of Great Britain, and the Glasgow and West of Scotland Branch of it. The Exhibition Committee includes Mr. Alex. Wilson, the Corporation Gas Engineer and Manager, Mr. S. B. Langlands, the Inspector of Lighting, Mr. Peter Fyfe, the Sanitary Inspector, and Mr. W. W. Lackie, the General Manager of the Electricity Department. The Manager is Mr. James M. Freer; the offices are at 38, Bath Street, Glasgow; and the exhibition will be held in the "Zoo."

The exhibits will comprise: (1) Smokeless fuels for furnaces and household use. (2) Domestic heating appliances, open coal-fire grates, stoves, ranges, draught regulators, &c. (3) Gas-fires and stoves, anthracite and other gas producers and generators for domestic heating. (4) Gas heating and cooking appliances. (5) Electric apparatus and electric heating and cooking appliances for domestic use. (6) Furnaces for heating rooms and buildings, hot-water and steam circulators. (7) Boiler furnaces, fuel economizers, smoke preventers, suction-gas plants, gas and other engines, electric appliances for generating power, &c., shop-window lighting, photography with high-pressure gas, mantle making, and high-pressure gas appliances. Lectures and demonstrations will be given daily; and arrangements have been made for competitions in all kinds of cooking, baking, &c., by gas and electric appliances for young ladies between the ages of twelve and seventeen.

SMOKE ABATEMENT CAMPAIGN.

Cheaper Gas Advocated at a Bolton Meeting.

Gas as a means of lessening the smoke evil was discussed at a meeting convened by the Bolton Housing and Town Planning Society, and held in the Borough Hall last Tuesday evening.

The principal speaker was Mr. J. Geldard, of Bolton, who said that the household smoke was more difficult to deal with than that from factories and workshops, as in the case of the latter the problem could be solved by the utilization of mechanical appliances now on the market, without loss of money to the manufacturers using steam power. It had been found that about 5 per cent. of the total weight of coal used in the domestic fire passed up the chimney in the form of smoke, or that from 10 to 15 lbs. of carbonaceous matter passed up the chimneys of ten houses every ten hours. The solution might come in one of two ways—either by the use of some form of smokeless fuel or gas. Electricity appeared at present to be hopelessly out of the question, on account of its cost. The smokeless fuel might be obtained either as anthracite coal or some specially prepared form of coke. So far as the Bolton district was concerned, anthracite would cost much more than their coal; and the question of coke was more in the hands of the gas committees. As made at present, coke was not very suitable for open fires, as it did not ignite readily; but by carbonizing coal at a lower temperature, whereby less gas would, of course, be obtained, a coke could be produced which would be good for household purposes. This could be used in existing grates. Gas-fires, however, offered advantages over coal or coke in that they required only a minimum of trouble in lighting; and there was no dirt to deal with. He admitted that, with gas at its present price, the cost of these fires would be more than coal-fires; but this was a difficulty which would be overcome when gas undertakings were not required to hand over large sums out of profits in relief of rates. Gas committees would then be in a position to reduce the price of gas to practically cost. More efficient still would be the substitution for the present luminons gas of a non-luminous gas delivered under pressure to the houses.

In the discussion, there was a consensus of opinion that, with cheaper gas, employers of labour, as well as the public, would be induced to use this commodity in greater quantity for the purposes of power and heating, and in this way do much to lessen the smoke evil.

Staffordshire Potteries Water Supply.

At the monthly meeting of the Stoke-upon-Trent Borough Council last Thursday—the Mayor (Alderman F. Geen) presiding—a long and important discussion took place on the minutes presented by the Water Committee. At a meeting of the Council held last September, the purchase of the undertaking of the Staffordshire Potteries Water Company, at an estimated cost of £1,000,000, was considered, and a resolution was passed declining to proceed further in the matter until the Water Committee had submitted a definite scheme to the Council. The Committee reported that they had instructed the Town Clerk to prepare the outline of a scheme for presentation at a further meeting of the Committee, and had appointed a Sub-Committee to confer with the Town Clerk on the matter. His report had been received; and, after giving it full consideration, the Committee recommended that the Corporation should oppose the Bill promoted by the Water Company to obtain further powers, unless a clause is inserted giving the Corporation the option of purchase within a limited number of years; also that the Parliamentary Agents be instructed to prepare a petition in opposition to the Bill and retain Counsel. The Mayor pleaded for delay. He said a conference had been arranged with the Directors of the Company, and they ought not to engage Counsel until they knew what concessions, if any, the Company were prepared to make. He proposed that the matter should be deferred until the decision of the Directors had been given. The proposition was not favourably received; and the Committee's recommendations were adopted by a large majority.

Lord Mayor of Manchester and Cheaper Gas.—In the course of a speech made at the annual dinner of the Consular Association in Manchester last Tuesday, the Lord Mayor of Manchester (Mr. S. W. Royse) expressed the opinion that an amalgamation of Salford with Manchester would be to the advantage of both; and, referring particularly to the municipal undertakings, he said the Manchester Gas Department was a great one. He hoped the difficulties the City Council were at present placing in the way of the Gas Committee would disappear, and that, as a consequence of cheaper gas, they would have less smoke and more industry in the city, and an improvement in the health of the people. He would like to see the gas industry encouraged for purposes of cooking, heating, lighting, and power. The Mayor of Salford (Alderman Linsley), speaking later at the same gathering, said that the question of amalgamation was probably dead.

SOCIETY OF ARTS AND THE GAS INDUSTRY.

Some Early Awards.

The Secretary of the Royal Society of Arts (Sir Henry Trueman Wood, M.A.) has been engaged in writing a history of the Society; and the results of his labour—we are sure it is a labour of love—have been appearing in the weekly "Journal." In the current number, the period of the introduction of gas lighting is reached; and the following is Sir Henry's account of the Society's connection with it.

After the application of gas for illuminating purposes by Murdoch in 1792, we find a few prizes offered and awarded for improvements connected with gas lighting. In 1797, a prize was offered for "a substitute for tar;" but though the offer remained open for many years, it does not seem to have attracted any competitors. This is remarkable, because the production of tar from coal had been known and practised for a considerable period. In 1681, letters patent had been granted to John Joachin Becher and Henry Serle for "a new way of makeing pitch and tarre out of pit coale." These inventors were followed by several others; among them the Earl of Dundonald, who had a patent for obtaining tar and other products from coal.

In 1810, B. Cook, of Birmingham, describes a process for the distillation and utilization of gas tar, which he said was at the time a waste product, though considerable amounts were made in the production of gas and the coking of coal. The tar, Cook stated, was superior to the "common tar" for ships' timbers. The more important part of the communication related to a method of distilling the tar, from which a "liquor or volatile oil" (light oil) was obtained, and a "residuum" (pitch) "equal to the best asphaltum." He had varnish made from the pitch and the light oil, and sent in a sample of work treated with the varnish. For this paper, which was certainly among the early practical proposals for the utilization of the bye-products of gas manufacture, Cook received the very inadequate reward of a silver medal. He, however, had been anticipated by Winsor, whose patent specification of 1804 refers to the production and utilization of various bye-products from gas making. Still, Cook's paper is full of interest, as he appears to have been an original worker, and to have achieved a considerable measure of practical success.

In 1808, a silver medal was given to Samuel Clegg "for his apparatus for making carbonated hydrogen gas from pit coal, and lighting factories therewith." The apparatus included a gasholder of the form now generally employed, of which Clegg was apparently the inventor. He was apprenticed to Boulton and Watt, and was in business in Manchester as a builder of steam-engines. He was the inventor of the gas-meter, which he patented in 1815; but (probably because it was the subject of a patent) he did not submit it to the Society. In 1819, a gold medal was given to John Malam for improvements on Clegg's original meter.

It is worth mention that the well-known telescopic gas-lamp, or chandelier, which is in common use up to the present date, was invented by William Caslon, who received a silver medal for it in 1817. The drawings in the "Transactions" show a chandelier identical with the most modern form, with sliding tubes, water-seal, and counterbalance weights."

BACUP CORPORATION WATER UNDERTAKING.

Local Government Board Inquiry.

An inquiry on behalf of the Local Government Board has lately been held by Mr. A. G. Drury, one of their Inspectors, in the Town Hall, Bacup, concerning an application by the Corporation for sanction for the construction of the Cragg high-level reservoir outside the statutory limits of deviation, and for authority to borrow £22,000 which has been overspent on the water undertaking.

The Town Clerk (Mr. J. Entwistle) stated that originally the Corporation had authority, granted in 1898, to borrow £14,000, repayable in sixty years. In 1904, they obtained the Bacup Corporation Act, which gave them additional borrowing powers for £5000. Further borrowing powers for £25,000 for extensions of works were authorized; forty-five years being allowed for repayment. Apart from the legal question, there were points in favour of the change of site; and these weighed with the Corporation. When the original site was carefully examined, it was found to be undermined with old coal workings. The Cragg site, on the other hand, was absolutely sound; and they could construct there a reservoir double the capacity of the original one.

Mr. *James Diggle*, Assoc.M.Inst.C.E., in reply to the Town Clerk of Rawtenstall (Mr. J. Whalley), said that the capacity of Spring Holes reservoir would have been 1¼ million gallons, but the Cragg reservoir would hold 2½ millions.

The Town Clerk proceeded to state that the Corporation entered into a contract for the construction of the Cowpe reservoir on July 7, 1900; but the Contractor (Mr. T. Taylor), in excavating for the trench, came upon a huge fault in the formation of the substrata. The contract was completed in 1909, and certain disputes arose between the Corporation and the Contractor, who claimed £23,210. The disputed item was somewhere about £15,000; and the Arbitrators to whom the matter was submitted awarded £13,746. At present, more than one-half of the houses in the borough were on the town's water supply; and of the population of 22,000, 14,000 had it. The present works at Cowpe were designed for a population of 40,000; but since 1894 the population had been practically stationary. The present rate to provide for the deficiency on the water undertaking was no less than 2s. in the pound; and it would have to be increased by the addition of the sinking fund and interest on the £22,000 applied for. The Corporation asked the Board to sanction the borrowing of the balance of the loan; leaving the amount spent in respect of the Cragg reservoir until parliamentary sanction was obtained.

Coal Strike.

"TO be or not to be," that is the question everyone is asking with regard to the coal strike, and it may not be finally known until the eleventh hour. If it does take place, the country will be faced with a more serious problem even than the Railway Strike.

Never before has such an exceptional opportunity presented itself to the Gas Industry for making Gas Cooking and Heating popular, and a reminder now to your consumers to use gas for all purposes—thus reserving their store of coal—will result in many new adherents.

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Advertisement of the RICHMOND GAS STOVE & METER CO., LTD., London and Warrington.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

On Thursday evening, out of a final short leet of three, Mr. D. Vass, of Airdrie, was elected to the position of Gas Manager at Perth, rendered vacant by the resignation of Mr. W. B. M'Lusky, who, as previously announced, has been appointed to a similar position at Halifax.*

Last Tuesday, the Provost, Magistrates, and Town Council of Alloa made an official inspection of the electricity station, which has been erected and equipped in connection with the Corporation Gas-Works for the generation and supply of electric light to consumers. The visitors were accompanied by Mr. Alexander Yuill, the Gas Manager of Dundee (formerly of Alloa), Mr. W. A. Ker, Consulting Engineer, Glasgow, Mr. J. W. Napier, the Gas Manager, and Mr. W. Tulloch, the Electricity Manager. The station consists of a large open-roofed building 120 feet long by 29 feet broad, and contains three powerful gas-engines of the most improved type and design. The visitors expressed great satisfaction at all the arrangements. It may be stated that the current had previously been supplied by the British Electric Plant Company, and some time ago an arrangement was made whereby the Town Council took over its generation and distribution.

At a meeting of the Directors of the Coatbridge Gas Company held on Thursday, after consideration of the accounts for the past year, it was agreed to reduce the price of gas to 1s. 6d. per 1000 cubic feet —a reduction of 1d. on the present rate. It was claimed that the reduction would more than compensate for the small charge made for the hire of gas cookers and fires.

A proposal was made at the meeting of the Gas Committee of the Dundee Town Council on Tuesday that the salary of Mr. Alex. Yuill, the Gas Manager and Engineer, be increased by £100 per annum. By five votes to two, the motion was agreed to.

There has been issued to the members of the Dundee Town Council a statement showing the development of the gas-works in ten years. The gas made, it is shown, has risen by 266,400,000 cubic feet, or 40 per cent., while, although £50,757 has been added to the capital expenditure during the period, the capital per million feet of gas has dropped from £645 to £409. During the same period, £45,627 of debt has been paid off. The coal used has gone up 17,314 tons per annum, the price has gone down by 1s. 9¼d. per ton, and the cost of carbonizing is 2s. 1¾d. per ton less. The net cost of production is nearly 11d. per 1000 cubic feet lower; and the average rate charged for gas shows a decrease of 1s. 1½d. per 1000 cubic feet. There are 36,563 tons more coke sold than was the case ten years since, and 290 tons of sulphate of ammonia made.

A prospectus has been issued by the Corporation of Glasgow regarding the Smoke Abatement Exhibition which it is proposed to hold in the Zoo Buildings, New City Road, from Sept. 20 to Oct. 12 this year. Organized by the Corporation, the exhibition will be under the auspices of the Society of British Gas Industries, the British Electrical and Allied Manufacturers' Association, the Coal Smoke Abatement Society, the Smoke Abatement League of Great Britain, and the Glasgow and West of Scotland Branch of the Smoke Abatement League. The exhibition, while it will follow to a certain extent the lines of the one held in 1910, will have among its exhibits every up-to-date contrivance for the complete combustion of solid fuel, and the most modern developments in heating, cooking, and lighting and ventilation by means of gas and electricity.

As is shown by a report which has just been issued to the members of the Lighting and Fires Committee of the Aberdeen Town Council, says the "Aberdeen Journal," Mr. J. A. Bell, the Electrical Engineer, does not agree with Mr. Samuel Milne, the Gas Engineer, that gas is superseding other forms of lighting. Mr. Milne, on March 31 last, issued to the Lighting Sub-Committee a report and tabulated statement giving particulars of various types of gas burners and lamps which the Gas Department had erected for inspection in Albyn Place, Queen's Road, and Fountainhall Road. Mr. Milne concluded his report as follows: "For public lighting gas is superseding other forms of lighting in London, in the Provinces, and in the leading cities of the Continent." Mr. Bell challenges Mr. Milne to make good this assertion.

At a meeting of the Gas Committee of the Aberdeen Town Council on Wednesday, it was reported that the gas exhibition, with the sum given by the Town Council, had left a small profit. It was also reported that the number of gas cooking appliances on loan or hire on Aug. 31 was 3609, and on Jan. 20, 6438—an increase of 2829. There were also on the first-mentioned date 1505 gas heating appliances on hire, and on Jan. 20, 3043—an increase of 1538. The total increase in cooking and heating appliances since the gas exhibition was 4367.

In connection with the opposition by the Falkirk Town Council to the Provisional Order being promoted by Mr. George Balfour, of London, during the week ward meetings have been held and plebiscite cards have been issued to the ratepayers. The Town Council, in order to protect the gas undertaking in the Larbert district, are seeking powers to go on with another burgh extension scheme.

The Perth Town Council on Monday approved of the petition that had been prepared against the Loch Ericht Water and Electric Power Provisional Order. It was explained by the Lord Provost that similar petitions were to be presented by the Tay District Fishery Board and the County Council.

William Tulloch appeared before Sheriff Maconochie at a pleading diet of the Edinburgh Sheriff Court on Friday, on a charge of having, between Aug. 26, 1909, and Nov. 5, 1910, while in the employment of the Loanhead Gas Company as Gas Manager, embezzled £95 5s. A plea of "Guilty" was tendered. Mr. Leys, solicitor, who asked for a lenient sentence, said Tulloch was only 28 years of age, and had a wife and three children. His Lordship passed sentence of three months' imprisonment.

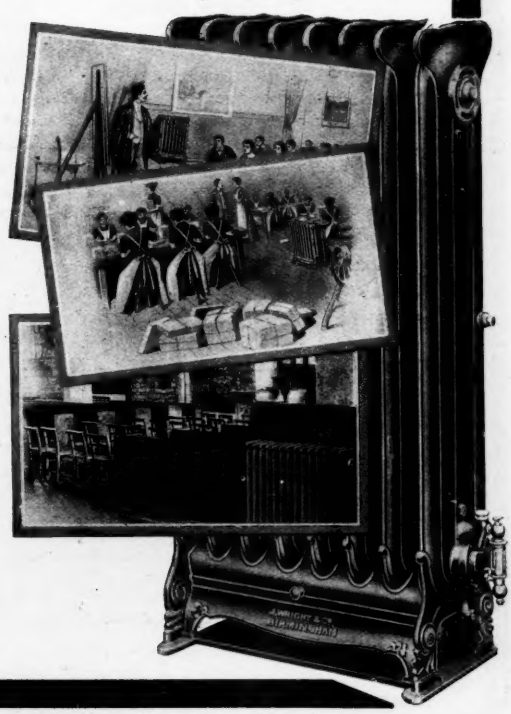
* An outline of Mr. Vass's career is given elsewhere.—ED. J.G.L.

The Proof——is in the Heating.

AS every Gas Engineer knows, it takes something more than a mere gas burner to properly heat an apartment.

BETWEEN so primitive a heating apparatus as a mere burner at the one extreme, and the "ST. ANDREW" Gas-Heated Steam Radiator at the other, there are a number of appliances for Gas Heating, many of which are also claimed to be the **most** effective, economical, and durable.

THE claims of the "ST. ANDREW" are not of this unimpressive kind. They are based not only on an experience of FIFTY YEARS in the making of Gas Appliances, but upon actual tests made in our completely equipped laboratories. The "ST. ANDREW" is warming to-day many thousands of Shops, Schools, Places of Worship, and similar buildings, and has never once been known to fail.



JOHN WRIGHT & CO.,
Essex Works,
BIRMINGHAM.

284.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Jan.* 27.

Sulphate of Ammonia.

There is little new to comment on in the situation of this article, and values have remained practically without fluctuation throughout the week. The cotton lock-out being ended, and negotiations proceeding as regards the coal strike, consumers generally are inclined to await developments before making further purchases on an extensive scale; but the dealers' requirements have kept the market steady meantime. The closing quotations still are £14 7s. 6d. to £14 8s. 9d. per ton f.o.b. Hull, £14 8s. 9d. to £14 10s. per ton f.o.b. Liverpool, and £14 11s. 3d. to £14 12s. 6d. per ton f.o.b. Leith. In the forward position, not much business has transpired; but it is reported that £14 10s. per ton, f.o.b. Liverpool, has been paid for January-June delivery in equal monthly quantities.

Nitrate of Soda.

The market for this article is unchanged in either tone or value, and holders are firm at 10s. 1½d. per cwt. for ordinary and 10s. 4½d. for refined quality, on spot.

LONDON, *Jan.* 29.

Tar Products.

The markets for tar products remain very firm. Pitch is still fairly good; but no higher prices are reported to have been paid. In 90 per cent. benzol, several parcels have been offered during the past week at slightly lower prices without finding buyers. Solvent naphtha is still in good demand, with a fair amount of inquiry for the forward position also. Heavy naphtha maintains its price. Though crude carbolic acid remains firm for near delivery, several lots have been offered for July-December at to-day's quotations without finding any buyers. Creosote is very firm; and there is a large inquiry for both prompt and forward delivery.

The average values during the week were: Tar, 23s. 3d. to 27s. 3d. *ex* works. Pitch, London, 44s. to 44s. 6d.; east coast, 43s. to 43s. 6d.; west coast, Clyde 41s. 6d. to 42s. 6d., Manchester 41s. 6d. to 42s. 6d., Liverpool 42s. 6d. to 43s. 6d. Benzol, 90 per cent., naked, London, 11d.; North, 10d. to 10¼d.; 50-90 per cent., naked, London, 10d. to 10¼d.; North, 9½d. to 10d. Toluol, naked, London, 10d.; North, 8½d. Crude naphtha, in bulk, London, 4½d. to 5d.; North, 3⅞d. to 4½d. Solvent naphtha, naked, London, 11d. f.o.b.; North, 10d. to 10¼d. f.o.b. Heavy naphtha, naked, London, 11½d. to 1s. 0½d. f.o.b.; North, 10d. to 10¼d. f.o.b. Creosote, in bulk, London, 2⅝d. to 3¼d.; North, 2½d. to 2⅝d., salty; 2⅝d. to 2¾d., liquid. Heavy oils, in bulk, 3¼d. to 3⅜d. Carbolic acid, casks included, 60 per cent., east coast, 3s.; west coast, 3s. Naphthalene, £4 10s. to £10; salts, 40s. to 45s., bags included. Anthracene, "A" quality, 1½d. to 2d. per unit, packages included and delivered.

Sulphate of Ammonia.

There has been no change in the market during the past week, and buyers have been scarce; but prices have been well maintained. Actual Beckton is £14. Outside London makes are £13 12s. 6d.; Leith, £14 10s.; Liverpool, £14 8s. 9d.; Hull, £14 7s. 6d.; Middlesbrough, £14 7s. 6d.

COAL TRADE REPORTS.

Northern Coal Trade.

There has been much less excitement in the coal trade, and prices are easier. The shipments of coal have been impeded by the delay of steamers through the stormy weather. More fuel has been available, therefore, for home users; and there has been less pressure to buy, as the belief is in an ultimate peaceable settlement of the labour difficulty. Steam coals have eased off. Best Northumbrians may be quoted at about 14s. per ton f.o.b.; while second-class steams are about 13s. per ton. Steam smalls are firm. In the gas coal trade, the demand continues strong with heavy exports; and for quantities above contract deliveries high prices are asked. Best Durham gas coals are about 14s. 9d. per ton f.o.b.; and second class are about 13s. 3d. to 13s. 6d. For "Wear specials," the current quotation is about 15s. 6d. per ton f.o.b. It is believed that one sale of gas coal has been made for delivery over the year at about 11s. 6d. per ton f.o.b. But there is not much doing at present in the way of contracting, as is usual at this season; and with freights still rising to the ports of the Mediterranean, there is some determent to arranging such sales. Coke is firm. The large output of gas coke is now readily taken up—the f.o.b. price of good makes being about 15s. per ton.

Scotch Coal Trade.

The coal trade is very brisk in all departments. While there are indications that the demand is not quite so great as that of a week or ten days ago, prices show no material alteration. Stocks are continued to be laid in against possible eventualities; and this keeps prices above their normal level. Prices may be quoted as follows: Steam, splint, ell, and treble nuts at about 12s. 6d. per ton f.o.b. Glasgow. Doubles fetch about 11s. 6d., and singles 10s. 6d. In the Lothians, it is difficult to get accurate prices, especially as at many of the pits the demand exceeds the supply, and only day-to-day orders are being booked. Approximate prices may, however, be given as: Best screened steam coal, 13s.; washed trebles, 12s. 6d.; washed doubles, 11s. 6d.; washed singles, 10s. 6d. to 11s.; and rough dross, from 9s. to 10s.—all f.o.b. at Leith. In the export market, shipment has been checked on account of the high prices.

At a parish meeting held at Stalbridge (Dorset) to consider the provision of a water supply, it was resolved "that the question be adjourned till the next dry summer."

R. & J. DEMPSTER, LIMITED, MANCHESTER.

Leading Makers of SPIRAL GUIDED GASHOLDERS.

Spiral Plates
Steel Tested
Special Rails
Smooth Rollers
Steady Action
Strong Details
Save Capital
Safe and Sure
Stand Severe
Snow Storms and
Stiffest Gales
Successfully.

From a Photograph showing the conversion of a Two-Lift Guide Framed Holder to a Four-Lift Spiral Holder of 3½ million cubic feet capacity, for the Newcastle and Gateshead Gas Company, to Plans and Specifications of W. D. GIBB, Esq., M.Inst.C.E., Engineer.

Littleborough Gas Company.

The ordinary half-yearly general meeting of this Company was held last Thursday, under the presidency of Mr. J. C. Hudson. The balance-sheet for the six months ended the 31st of December was submitted and passed. The gas sales realized £4554, compared with £4687 in the corresponding period last year; the decrease in revenue being due to the reduction in price. In the six months, 34½ million cubic feet of gas were sold, which shows a considerable increase on previous results. The sale of residual products brought in £1350, against £1264. The profit on the revenue account was £1481; and the disposable balance £3325. The Chairman, in moving the adoption of the balance-sheet, expressed pleasure in reporting the continued progress of the Company. He pointed out that the gas sales during the year reached 68 millions—an increase of 5 per cent. on the year 1910. This was especially gratifying, considering the economies effected by consumers in utilizing the incandescent burner. Many of the mills in the district had installed the high-pressure system of lighting in preference to any other method of illumination, and this had resulted in a considerable reduction in the consumption of gas—in some cases amounting to 50 per cent.; but it gave more satisfaction to the Directors to know that consumers were obtaining increased efficiency at less cost, as this result was mutually beneficial. Notwithstanding this, the general demand for gas for lighting was still on the increase; while for cooking, heating, and industrial purposes, the consumption had more than trebled during the last ten years. The use of gas for cooking and other household purposes was still growing, and its extensive adoption was sufficient evidence of its economy and utility. Gas-fires for domestic heating were now more generally appreciated; and the Company were prepared to encourage consumption in this direction by making easy terms for appliances, while the present charges for gas rendered this form of heating most economical. That the low price charged for gas for power purposes appealed to gas-engine users was proved by the fact that the consumption of gas for engines had more than doubled during the last few years. The residuals market was satisfactory; and the local demand for gas coke was increasing. The Company supplied coke broken to sizes suitable for domestic purposes; and there was evidence of a growing use of this fuel for household fires. The balance-sheet was adopted, and a dividend of 10 per cent. per annum (less income-tax) was declared. The shareholders expressed themselves satisfied with the report; and thanks were accorded to the Directors and officials of the Company (of which Mr. S. E. Halliwell is the Engineer, Manager, and Secretary) for their services.

Sale of the Bloxham Water-Works.—In accordance with the intimation given in the advertisement columns of the "JOURNAL," Messrs. A. & W. Richards offered for sale, at the Mart, Tokenhouse Yard, E.C., last Tuesday, as a going concern, the freehold water-works at Bloxham; and they fetched £1020.

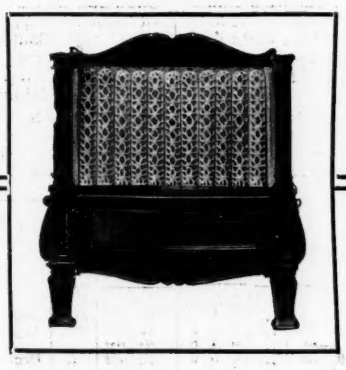
Sale of Stocks and Shares.

An important sale of stocks and shares, which included two new issues of capital by order of Directors, was conducted by Messrs. A. & W. Richards, at the Mart, Tokenhouse Yard, E.C., last Tuesday. The first lots consisted of £1000 of 4 per cent. perpetual debenture stock and £4000 of new ordinary stock of the Great Yarmouth Water Company. The former sold at £105 5s. per £100; and the latter (which will carry 4 per cent. per annum dividend from the 24th prox.) at £90 to £92 5s. each. Then followed an issue of new ordinary £10 shares in the Southend Water Company, ranking for a maximum dividend of 5 per cent., and carrying 4½ per cent. They were sold at par. Under instructions from Executors, a few fully-paid £10 additional shares in the Haywards Heath District Gas Company, ranking for a standard dividend of 7 per cent., subject to the sliding-scale (the dividends for the five years ended Dec. 31, 1910, having been at the rate of £9 12s. 6d. per cent.), were offered for sale, and fetched £18 5s. apiece. By order of the Senior Official Receiver and Liquidator of the Birkbeck Permanent Benefit Building Society, £500 of new ordinary 5 per cent. "B" stock of the Southend Gas Company realized £113 10s. to £114 per £100; the purchasers taking the dividend of £2 15s. per £100 accruing from July 1, 1911.

Tar-Spraying Roads in Lancashire.

The Main Roads and Bridges Committee of the Lancashire County Council having been promised a grant of £5000 by the Roads Board, have circularized the various local bodies to ascertain whether they are in favour of the continuance of tar-spraying. The Committee state that they have been simply inundated with complaints from farmers and horse-owners, alleging that the tar makes the roads slippery, while, on the other hand, they have the fact that tar-spraying reduces the dust evil, lessens the damage done by motor traffic; and so lowers the cost of maintenance. The Littleborough District Council decided, at their meeting last week, to reply to the circular, requesting that the roads may be again tar-sprayed in the spring. The Clitheroe District Council have instructed the Clerk to write to the County Surveyor to the effect that the Council did not condemn tar-spraying, but would like to know if the system could not be so modified as to minimize the danger to horses. The West Lancashire Council favour spraying; and they have asked for its continuation next summer. The Bury Rural District Council passed a resolution to the effect that they had so few tar-sprayed roads in their area that they were not prepared to express an opinion. At their meeting in Blackburn, the Roads Protection Society discussed the question of proposed actions against the County Council for damages in consequence of accidents arising from tar-spraying; and it was decided that, as "reasonable notice" had been given to the Council, the matter should now be referred to the Society's Solicitor to be dealt with. It was also resolved to keep an "occurrence book," in which accidents from tar-sprayed roads and complaints are to be entered.

MAIN'S 'ADAPTABLE'



What it is.

A means to adapt an ordinary modern interior for use with gas without necessitating any structural alteration.

It fits into and forms an integral part of the interior and gives an efficiency equal to an ordinary Gas Fire.

It is raised sufficiently off the floor to clear the bottom bars of the grate, which need not be removed.

What it is not.

It is not a separate unit and does not stand out in front of the interior, or spoil the appearance of an artistic mantel register.

Nor is it a mere "basket" fire which lies at the back of the grate and gives a low efficiency.

R. & A. MAIN, LIMITED.

WORKS: Gothic Works, EDMONTON, N.; Gothic Ironworks, FALKIRK; and Gothic Works, BIRMINGHAM.
SHOW-ROOMS AND BRANCHES: 25, Princes St., Oxford Circus, W.; 136, Renfield St., GLASGOW; 56, Broad St., BIRMINGHAM; 83, Old Market St., BRISTOL; 13, Whitworth St. West, MANCHESTER; 8, Exchange Place, Donegall St., BELFAST; 333, Queen St., MELBOURNE; and 12, Cunningham Lane, Pitt St., SYDNEY, N.S.W.

Gas Companies as Chemical Manufacturers.

Referring to the action of the Chemical Section of the London Chamber of Commerce, in regard to the clauses of Gas Bills for next session relating to the manufacture of chemicals, referred to in the "JOURNAL" last week, the "Chemical Trade Journal" on Saturday said: "On our part we think that the chemical manufacturer has awakened a little too late; and to talk nowadays about the elements of free competition is to get away from realities. In spite of much lip service to 'free trade' there is little real freedom in the distribution of commodities, especially in the chemical trade itself, which is honeycombed from top to bottom with restrictive agreements. The economy from the cutting-out of the intermediate profits is so obvious, that it is not surprising that the tendency towards 'vertical expansion' . . . has been a big element in the business policy of all large gas-works. Moreover, the linking together of kindred chemical processes under one management is, of course, economically sound. Notwithstanding this, however, the case of the chemical manufacturer is not to be dismissed as purely reactionary. Gas companies are in a privileged position. Competition is confined to fighting the electrical people; for gas companies cannot fight each other in the way that rival tar distillers can. Gas companies have a steady market for gas provided for them by Parliament, out of which handsome profits are derived. So it is easily seen that any great development by the companies towards the manufacture of products from residuals would imperil the private manufacturer. We are afraid that, precedents apart, the gas companies will develop along the lines of the proposed Acts; and the private chemical manufacturer will be compelled to modify his works, and adapt himself to changed conditions."

Reduction in Price at Reading.—The Reading Gas Company have reduced the price of gas to 2s. 4d. per 1000 cubic feet.

Electric Light Wire Causes Fire at Ilkeston.—An alarming incident occurred in a shop in Bath Street, Ilkeston, last Friday afternoon. An electric wire fusing and burning through a lead gas-pipe ignited the gas, and caused a fire in the premises. The shop is in the occupation of Messrs. Cash and Co., boot dealers, and at the time of the occurrence the Manager (Mr. A. R. Clayton) was on the spot. He was alarmed to see a large flame issue from a fuse-box. The flame died down; but a few moments later there was another flare—a gas-pipe near the box having been burnt through and the gas ignited. Telephone messages were sent to the Fire Brigade for help, and to the electric light department for the current to be cut off. Meanwhile, buckets of water had been thrown on to the flames, which were extinguished before the arrival of the brigade.

Metropolitan Water Board and the Refunding of Over-Payments.—At the meeting of the Metropolitan Water Board last Friday (the first after the Christmas recess), the Appeal and Assessment Committee reported on the subject of the refunding by the Board of over-payments made to them. At a conference representative of constituent authorities, held at the Westminster City Hall last month, the following resolution was adopted: "That this conference of delegates appointed by the authorities represented on the Metropolitan Water Board views with grave dissatisfaction the practice of the Board in refusing to refund for more than one year over-payments received from consumers in mistake. That, in the opinion of this conference, refund should be made in such cases up to a period of not less than three years from the last quarter day; and that the practice of pleading the Public Authorities' Protection Act by way of defence to such claims is to be strongly deprecated." The Committee reported that there is no such "practice" as that referred to; and that every case is considered on its merits. Mr. S. S. Elliott, the Vice-Chairman of the Board, said that out of 300 appeals considered by the Committee, all the applicants with the exception of six had expressed themselves satisfied.

GAS COMPANIES' STOCK AND SHARE LIST.

The Stock Exchange has had a tame and, for the most part, uninteresting week, owing to a variety of causes. Foreign politics (except German elections) have dragged on with very little change; and burning questions at home (notably the labour one) have done ditto. Added to this, the long nineteen-day account is always an influence the reverse of stimulating. The chief markets thus were often quite lethargic. The opening day was inactive and rather dull—most departments showing lower prices. Home Government issues were heavy; but Consols did not move. Railways were less cheerful, and commanded rather lower figures; and Americans were giving way at the close. Tuesday was no busier and no brighter. Weakness affected the gilt-edged division, and Consols fell ¼. Rails were irregular, but generally rather uneasy as to labour prospects. The Foreign Market was fairly firm. Wednesday was very quiet most of the day, but roused up a bit in the afternoon. Rails revived somewhat, and prices were rather firmer; but other chief markets were rather poor. Business was irregular on Thursday; some markets being alive and others quite dormant. Government issues and Rails were among the best; but Consols did not move. Friday's business was slack, and the tone was far from strong. Gilt-edged securities were dull, and Consols fell ¼. Rails were irregular; but most of them were lower on dissatisfaction with the labour outlook. Americans were quite flat. Saturday's business was quiet and devoid of any marked characteristic. Consols closed unchanged at 77⅛-77⅜—a fall of ¼ in the week. In the Money Market, there was a fair demand which kept rates firm; but the disposition was towards ease at the close. Business in the Gas Market was about on the same scale of activity as the week before; and the general tendency throughout the list was equally firm. Changes in quotation were few, but were all in the upward direction. The half-year's accounts, so far as they have come to hand, are satisfactory; the companies having earned their full statutory dividends with increased balances to carry forward. In Gaslight and Coke issues, the ordinary was moderately active and very firm, transactions ranging from 105¾ to 106½. The secured issues were again unusually active; the maximum realizing from 85⅝ to 87, the preference 103, and the debenture from 79 to 79⅝. South Metropolitan was firm and unchanged; all dealings being within the limits of 116½ and 117. In Commercials, there were a couple of bargains in the 4 per cent. at 110½ and 111¼. Among the Suburban and Provincial group, Alliance and Dublin realized 79, Brentford old 259, ditto new 200, British 45¼, ditto debenture 93, Ilford 154½, South Suburban 122¼ and 122½ (a rise of 1), and Wandsworth debenture 73. On the local Exchanges, Liverpool debenture was done at 101½, and Newcastle at 103. In the Continental companies, Imperial marked from 190½ to 191½, ditto debenture 91, Union from 80 to 83, and European 21¼—a rise of ¼. Among the undertakings of the remoter world, Cape Town preference changed hands at 4 9/16, Primitiva at 7⅛ to 7⅝, ditto preference at 5¼ to 5⅝, and River Plate debenture at 95⅝ and 95¼.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
1,551,868	Stk.	Oct. 12	5	Alliance & Dublin Ord.	79—82	..	6 1 11
374,000	Stk.	Jan. 12	4	Do. 4 p.c. Deb.	91—93*	..	4 6 0
250,000	5	Sept. 28	7	Bombay, Ltd.	6—6½	..	5 7 8
50,000	10	Aug. 31	15	Bourne- mouth Gas & Water } 10 p.c.	29—30	..	5 0 0
311,810	10	"	7	B 7 p.c.	16½—16⅝	..	4 3 7
75,000	10	"	6	Pref. 6 p.c.	14¼—14⅝	..	4 1 4
380,000	Stk.	Aug. 16	13	Brentford Consolidated	257—262	..	4 19 3
330,000	"	"	10	Do. New	198—203	..	4 18 6
50,000	"	"	5	Do. 5 p.c. Pref.	120—122	..	4 2 0
206,250	"	Dec. 14	4	Do. 4 p.c. Deb.	97—99	..	4 0 10
220,000	Stk.	Aug. 31	11	Brighton & Hove Orig.	217—222	..	4 19 1
246,320	"	"	8	Do. A Ord. Stk.	157—160	..	5 0 0
490,000	20	Sept. 28	12½	British	44½—45½	..	5 9 11
120,000	Stk.	Dec. 29	4	Do. 4 p.c. Deb. Stk.	92—94	..	4 5 1
109,000	"	Aug. 16	6	Bromley, A 5 p.c.	127—132	..	4 10 11
165,700	"	"	4½	Do. B 3½ p.c.	97—102	..	4 8 3
82,278	"	"	5½	Do. C 5 p.c.	117—122	..	4 10 2
55,000	"	Dec. 29	3½	Do. 3½ p.c. Deb.	80—82	..	4 5 4
250,000	Stk.	"	4	Buenos Ayres 4 p.c. Deb.	94—96	..	4 3 4
100,000	10	—	—	Cape Town & Dis., Ltd.	2—3	..	—
100,000	10	—	—	Do. 4½ p.c. Pref.	4¼—5½	..	—
100,000	Stk.	Dec. 29	4½	Do. 4½ p.c. Deb. Stk.	76—80	..	5 12 6
157,150	Stk.	Aug. 16	5	Chester 5 p.c. Ord.	111—113	..	4 8 6
1,513,280	Stk.	"	5/9/4	Commercial 4 p.c. Stk.	110—112	..	4 17 7
560,000	"	"	5½	Do. 3½ p.c. do.	105—107	..	4 19 8
475,000	"	Dec. 14	3	Do. 3 p.c. Deb. Stk.	75—77	..	3 17 11
806,000	Stk.	"	4	Continental Union, Ltd.	81—84	..	4 15 3
200,000	"	"	7	Do. 7 p.c. Pref.	132—134	..	5 4 6
492,270	Stk.	—	5½	Derby Con. Stk.	122—124	..	4 8 9
55,000	"	—	4	Do. Deb. Stk.	104—105	..	3 16 2
840,150	10	July 28	10	European, Ltd.	20½—21½	+½	4 13 0
16,160,600	Stk.	Aug. 16	4/14/8	Gas- light and Coke } 4 p.c. Ord.	105½—106½	..	4 8 10
2,600,000	"	"	3½	3½ p.c. max.	85—87	..	4 0 6
4,062,235	"	"	4	4 p.c. Con. Pref.	103—104	..	3 16 11
4,531,705	"	Dec. 14	3	3 p.c. Con. Deb.	79—81	..	3 14 1
258,740	Stk.	Sept. 14	5	Hastings & St. L. 3½ p.c.	95—97	..	5 3 1
82,500	"	"	6½	Do. do. 5 p.c.	—	..	—
70,000	10	Oct. 12	11	Hongkong & China, Ltd.	17—17½	..	6 5 9
131,000	Stk.	Sept. 14	7½	Ilford A and C	154—157	..	4 15 6
65,780	"	"	6	Do. B	125—128	..	4 13 9
65,500	"	Dec. 29	4	Do. 4 p.c. Deb.	92—94	..	4 5 1
4,940,000	Stk.	Nov. 10	9	Imperial Continental	190—192	..	4 13 9
1,235,000	Stk.	Aug. 16	3½	Do. 3½ p.c. Deb. Red.	90—92	..	3 16 1
200,242	Stk.	Aug. 31	6	Lea Bridge Ord. 5 p.c.	125—130	..	4 12 4
561,000	Stk.	Aug. 16	10	Liverpool United A.	219—221	..	4 10 6
718,100	"	"	7	Do. B.	163—165	..	4 4 10
306,083	"	Dec. 29	4	Do. Deb. Stk.	100—102	..	3 18 5
75,000	5	Dec. 14	6	Malta & Mediterranean	4⅜—5	..	6 0 0
560,000	100	Oct. 2	5	Met. of } 5 p.c. Deb.	100—102	..	4 18 0
250,000	100	"	4½	Melbourne } 4½ p.c. Deb.	100—102	..	4 8 3
541,920	20	Nov. 10	3½	Monte Video, Ltd.	12—12½	..	5 12 0
1,775,892	Stk.	July 28	4½	Newc'tle&G'tesh'd Con.	102—104	..	4 4 2
529,705	Stk.	Dec. 29	3½	Do. 3½ p.c. Deb.	85—87	..	4 0 6
55,940	10	Aug. 31	7/7/0	North Middlesex 7 p.c.	14½—15½	..	4 14 10
300,000	Stk.	Dec. 14	8	Oriental, Ltd.	136—138	+2	5 15 11
60,000	5	Sept. 28	8	Ottoman, Ltd.	6⅞—7¼	..	5 10 4
31,800	53	Aug. 16	13	Portsea Island A	140—145	..	4 14 10
60,000	50	"	13	Do. B	133—138	..	4 14 2
100,000	50	"	12	Do. C	130—135	..	4 8 11
398,490	5	Oct. 12	8	Primitiva Ord.	7⅜—7⅝	..	5 4 11
796,980	5	Dec. 29	5	Do. 5 p.c. Pref.	5¼—5⅝	..	4 13 0
488,900	100	Dec. 1	4	Do. 4 p.c. Deb.	97—99	..	4 0 10
312,650	Stk.	Dec. 29	4	River Plate 4 p.c. Deb.	94—96	..	4 3 4
250,000	5	Sept. 28	12	San Paulo, Ltd.	10⅞—11⅛	..	5 6 8
115,000	10	"	6	Do. 6 p.c. Pref.	11½—12	..	5 0 0
125,000	50	Jan. 2	5	Do. 5 p.c. Deb.	49—50	..	5 0 0
135,000	Stk.	Aug. 31	10	Sheffield A	240—242	..	4 2 8
209,984	"	"	10	Do. B	240—242	..	4 2 8
528,500	"	"	10	Do. C	240—242	..	4 2 8
90,000	10	Sept. 28	6	South African	8—9	..	6 13 4
6,429,895	Stk.	Aug. 16	5/9/4	South Met., 4 p.c. Ord.	116—118	..	4 12 8
1,895,445	"	Jan. 12	3	Do. 3 p.c. Deb.	78—80*	..	3 15 0
209,820	Stk.	Aug. 16	8½	South Shields Con. Stk.	157—159	..	5 6 11
605,000	Stk.	"	5/16/8†	S'th Suburb'n Ord. 5 p.c.	122—124	+1	4 14 0
60,000	"	"	5	Do. 5 p.c. Pref.	117—120	..	4 3 4
117,058	"	Jan. 12	5	Do. 5 p.c. Deb. Stk.	119—121*	..	4 2 8
502,310	Stk.	Nov. 10	5	Southampton Ord.	107—109	..	4 11 9
120,000	Stk.	Aug. 16	7½	Tottenham } A 5 p.c.	145—148	..	4 16 3
483,940	"	"	5⅝	and } B 3½ p.c.	115—117	..	4 16 1
149,470	"	Dec. 29	4	Edmonton } 4 p.c. Deb.	94—96	..	4 3 4
182,380	10	"	5	Tuscan, Ltd.	8½—9	..	5 11 1
149,900	10	Jan. 2	5	Do. 5 p.c. Deb. Red.	99—101	+2	4 19 0
236,476	Stk.	Aug. 16	5	Tynemouth, 5 p.c. max.	114—116	..	4 6 2
255,636	Stk.	Aug. 31	6⅞	Wands- } B 3½ p.c.	143—146	+1	4 14 3
85,766	"	Dec. 29	3	worth } 3 p.c. Deb. Stk.	71½—73½	..	4 1 8

Prices marked * are "Ex. div." † Next dividend will be at this rate.

The Chorley Rural District Council intend to carry out improvements at the pumping-station of the Anderton and Heath Charnock water supply areas, by the installation of gas-engines in lieu of the steam plant now in use; and they have decided to consult Messrs. Tangyes, of Birmingham, as to the type of engine most suitable. It is expected that this will increase the supply without adding to the maintenance charges.

On the occasion of the Davis Gas-Stove Company's travellers' conference—a regular feature in the sales organization of the firm—which was recently held, all the members of the outdoor selling staff were present. The meeting was presided over by Mr. Cyril G. Davis; and the chief items on a long *agenda* paper concerned the details of the winter programme for the present year as regards steamless radiators and barless gas-fires.

An interesting and instructive lecture on "Hot Water" was given by Mr. W. Edgar, of Hammersmith, last Tuesday to the outdoor staff of the Brentford Gas Company, who assembled in large numbers. At the conclusion, Mr. Jennings proposed a vote of thanks to the lecturer; congratulating him on the good attendance, and also on the manner in which he had dealt with his subject from an expert point of view.

Messrs. Firth Blakeley, Sons, and Co., Limited, ask us to intimate that Messrs. W. Cooper Penn and Co., of Westminster (for some time their London agents), no longer act for them in any capacity; and that all communications for the present should be sent direct to their registered offices at Thornhill, Dewsbury. In future, the business there will be confined entirely to new apparatus; the second-hand plant department being dealt with as an entirely distinct branch, under separate management, at Church Fenton, near Leeds.

TAR PRODUCTS PRICES.

Representative manufacturers give the following as fair current values for the week ending Jan. 27. Prices are net, and they include the usual packages and delivery f.o.b., f.a.s., or f.o.r., as customary.

Article.	Basis.	London.	North-East Coast.	East Coast, Yorks.	West Coast.	
					Liverpool.	Manchester.
Tar, crude	per ton	—	24/- 28/-	24/- 28/-	—	24/- 27/6
Pitch	,,	—	45/-	45/3	—	—
Benzol, 90%	per gallon*	1/1¼	-/11½	1/-	1/-	-/11½
Benzol, 50-90%	,,	—	-/11	-/11	-/11	-/10¾
Toluol, 90%	,,	—	-/10½	-/11	—	-/10
Crude naphtha, 30%	,,	—	-/5	-/4½	-/5	-/5
Light oil, 50%	,,	—	-/4¾	—	-/4¾	-/4⅝
Solvent naphtha, 90-160	,,	—	-/10⅞	-/10½	—	-/10½
Heavy naphtha, 90-190	,,	—	-/11	-/11	—	-/11¼
Creosote in bulk	,,	—	-/2⅝	-/2 9/16	-/2⅝	-/2⅝
Heavy oils	,,	—	-/2⅝	-/2¼	—	-/2⅝
Carbolic acid, 60's	,,	—	3/1 3/1½	3/-	—	—
Naphthalene, crude drained salts	per ton	—	45/-	42/6	47/6	50/-
,, pressed	,,	—	60/-	63/-	60/-	60/- 75/-
,, whizzed	,,	—	—	—	70/- 72/6	65/- 75/-
Anthracene	per unit	—	-/1½	-/1½	-/1½	-/1½

WANTED, FOR SALE, CONTRACTS, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Appointments, &c., Vacant.

ENGINEER AND MANAGER. Lisburn Gas Department. Applications by Feb. 17.
MANAGER. Guisborough Gas Company. Applications by Feb. 1.
WORKS CHEMIST. Birmingham Gas Department.
WORKS FOREMAN. Merthyr Tydfil Gas-Works.
REPRESENTATIVE. No. 5515.
SHOWROOM SALESMAN (Gas Undertaking). No. 5511.
SLOT METER COLLECTOR AND CLERK. Merthyr Tydfil Gas-Works.
GAS-FITTER. No. 5513.

Appointments Wanted.

CHEMICAL PLUMBER, &C. No. 5492.
REPRESENTATIVE (Manufacturing Engineers). No. 5516.

Plant, &c. (Second Hand), Wanted.

SULPHATE PLANT. No. 5517.

Meetings.

GASLIGHT AND COKE COMPANY. Horseferry Road. Feb. 9. Twelve o'clock.
SOUTH SUBURBAN GAS COMPANY. De Keyser's Hotel. Feb. 2. Three o'clock.

Stocks and Shares.

SOUTHEND WATER COMPANY. By Auction. Feb. 20.

TENDERS FOR

Buildings, &c.
BIRKENHEAD GAS DEPARTMENT. Tenders by Feb. 15.

Coal.
MILFORD HAVEN URBAN DISTRICT COUNCIL. Tenders by Feb. 7.

Fire Clay Goods.
HEBDEN BRIDGE AND MYTHOLMROYD GAS BOARD. Tenders by Feb. 6.
TODMORDEN GAS DEPARTMENT.

Gasholders and Tanks.
BIRKENHEAD GAS DEPARTMENT. Tenders by Feb. 15.
SEAFORD GAS COMPANY. Tenders by Feb. 12.

General Stores (Steel and Iron, Bolts and Nuts, Tools, Paints, Oils, Asbestos Goods, &c.).
DEVONPORT GAS DEPARTMENT. Tenders by Feb. 10.
OSSETT CORPORATION. Tenders by Feb. 9.
STOCKTON-ON-TEES CORPORATION. Tenders by Feb. 14.

Mantles, &c.
DEVONPORT GAS DEPARTMENT. Tenders by Feb. 10.

Pipes, &c.
DEVONPORT GAS DEPARTMENT. Tenders by Feb. 10.

Purifiers and Purifier House, &c.
WALLASEY CORPORATION. Tenders by Feb. 14.

Retort Setting, &c.
TODMORDEN GAS DEPARTMENT.

Tar.
MANCHESTER GAS DEPARTMENT. Tenders by March 7.

Tar Spray of Highways.
OSSETT CORPORATION. Tenders by Feb. 9.

OXIDE OF IRON.

O'NEILL'S OXIDE
For GAS PURIFICATION
LARGEST SALE OF ANY OXIDE.

SPENT OXIDE PURCHASED IN ANY DISTRICT.

GAS PURIFICATION & CHEMICAL CO., LD.,
PALMERSTON HOUSE,
OLD BROAD STREET, LONDON, E.C.

WINKELMANN'S
"VOLCANIC" FIRE CEMENT.
Resists 4500° Fahr. Best for GAS-WORKS.
ANDREW STEPHENSON, 182, Palmerston House Old Broad Street, London, E.C. "Volcanism, London."

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Offices: City Chambers, LEEDS.
Correspondence invited.

J. & J. BRADDOCK (Branch of Meters Limited), Globe Meter Works, OLDHAM, and 45 & 47, Westminster Bridge Road, LONDON, S.E.
WET AND DRY GAS-METERS, PREPAYMENT METERS, STATION METERS AND GOVERNORS.
REPAIRS RECEIVE PROMPT ATTENTION.
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NYMEGEN, HOLLAND.

GENERAL MANAGERS—
London and South of England:
W. T. P. CUNNINGHAM,
13, Arcadian Gardens, Wood Green, LONDON, N.
North of England, Midlands, and Wales:
J. BROWN & CO., LTD., Savile Town, DEWSBURY.
Scotland and Ireland:
J. B. MACDERMOTT, 11, Bothwell St., GLASGOW.

OXIDE OF IRON.

SPENT OXIDE PURCHASED.

BALE'S FIRE CEMENT.

PAINT FOR GAS-WORKS.

"KLEENOFF." THE COOKER CLEANER.

BALE & CHURCH, LTD.,
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SPECIALLY prepared for the Manu-facture of SULPHATE OF AMMONIA.

SPENCER CHAPMAN & MESSEL, LTD.,
with which is amalgamated WM. PEARCE & SONS, LTD.
36, Mark Lane, LONDON, E.C. Works: SILVERTOWN.
Telegrams: "HYDROCHLORIC, LONDON."
Telephone: 1588 AVENUE (3 lines).

NOTICES TO CORRESPONDENTS, ADVERTISERS, AND SUBSCRIBERS.

No notice can be taken of anonymous communications. Whatever is intended for insertion in the "JOURNAL" must be authenticated by the name and address of the writer; not necessarily for publication, but as a proof of good faith.

Subscribers who desire to avail themselves of the reduction in the Subscription by paying in advance for the Year 1912, are reminded that this can only be done during January.

Orders for Alterations in, or stoppages of, PERMANENT ADVERTISEMENTS should be received by the FIRST POST on SATURDAY.

Wanted, For Sale, and Tender Advertisements, Six Lines and under, 3s.; each additional Line, 6d.

TERMS OF SUBSCRIPTION to the "JOURNAL."

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All Communications, Remittances, &c., to be addressed to
WALTER KING, 11, BOLT COURT, FLEET STREET, LONDON, E.C.
Telegrams: "GASKING, LONDON." Telephone: P.O. 1571a Central.

TAR WANTED.

THOMAS HORROCKS & SONS, LTD.,
Albert Chemical Works, BRADFORD,
MANCHESTER.
Pitch, Creosote, Brick and Fuel Oils, Benzol, Solvent Naphtha, Carbolic, Sulphate of Ammonia.

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SPECIALLY prepared for Sulphate of AMMONIA Makers by
CHANCE AND HUNT, LIMITED,
Works: OLDBURY, WEDNESBURY, AND STAFFORD.
Address Correspondence and Inquiries to OLDBURY, WORCS.
Telegrams: "CHEMICALS, OLDBURY."

D. ANDERSON AND COMPANY,
GAS LIGHTING ENGINEERS AND CONTRACTORS,
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THE very best Patent Grids for Holding Oxide Lightly.
See Illustrated Advertisement, Dec. 5, p. 663.

ENQUIRIES SOLICITED.

FOR Gas-Works Plant of Every Description; also SULPHATE OF AMMONIA and SULPHUR RECOVERY PLANTS,
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DONNINGTON, NEWPORT, SALOP.

GAS-METERS will not Freeze if CALCIDUM is added to the water.
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GAS-WORKS requiring Extensions should Communicate with FIRTH BLAKELEY, SONS, AND CO., LIMITED, Dewsbury, who make a Speciality of Catering for the Smaller Gas Concerns. Prices Reasonable; quality and results, the *best*. Satisfaction Guaranteed.

HYDRATED OXIDE OF IRON.

PREPARED from Pure Iron.
Twice as rich as Bog Ore.
Gives no back Pressure.
The Cheapest in the Market.
READ HOLLIDAY AND SONS, LTD., HUDDERSFIELD.

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AMMONIACAL Liquor wanted.
BROTHERTON AND CO., LTD. Ammonia Distillers.
Works: BIRMINGHAM, GLASGOW, LEEDS, LIVERPOOL, SUNDERLAND, AND WAKEFIELD.

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It is also used for the Enrichment of Gas.
Manufactured and supplied by C. BOURNE, West Moor Chemical Works, KILLINGWORTH, or through his Agent, F. J. NICOL, Pilgrim House, NEWCASTLE-ON-TYNE.
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BROTHERTON AND CO., LTD., Tar Distillers.
Works: BIRMINGHAM, GLASGOW, LEEDS, LIVERPOOL, SUNDERLAND, AND WAKEFIELD.

JOHN RILEY & SONS, Chemical Manufacturers, Hapton, near Accrington, are MAKERS of Special SULPHURIC ACID, for Sulphate of Ammonia Making. Highest percentage of Sulphate of Ammonia obtained from the use of this Vitriol, which has now been used for upwards of 50 years. References given to Gas Companies.

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BROTHERTON AND CO., LTD., Chemical Manufacturers.
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SULPHATE OF AMMONIA SATURATORS and all LEAD and TIMBER WORK in Connection with Sulphate Plants.
We guarantee promptness with efficiency for Repairs.
JOSEPH TAYLOR AND CO., CENTRAL PLUMBING WORKS, BOLTON.
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TAR WANTED.

THE BurndenTarCompany(Bolton),Ld.,
HULTON CHEMICAL WORKS, BOLTON.
JOSEPH A. HUTCHINSON, Managing Director.

MANAGER FOR GAS-WORKS IN ARGENTINE REPUBLIC. (NO. 5502).

ADVERTISER Thanks and Notifies all Applicants to the above Position that the VACANCY HAS NOW BEEN FILLED.

CHEMICAL Plumber and Leadburner (London), with Sound Practical Knowledge of the Making and Repairing of Saturators of all kinds, Chambers, Towers, Tanks, &c. Own Tools. Any distance (can take Lead). Good References. Work Guaranteed.
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Advertiser (48), Engineer with Commercial and Practical Experience, Constructional work, Lighting, Heating, Cooking, &c., Large Connection, Calling upon Companies, Corporations, Councils, &c., wishes to REPRESENT an Established Firm on Part Expenses and Commission.
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SMART Gas-Fitter, with Special Knowledge of Maintenance of all Types of Incandescent Burners, required to Canvass and Advise Consumers, Clean and Maintain Burners, and Assist in usual District Routine.
Apply, by letter, giving full Particulars only (no Testimonials), in own Handwriting, to No. 5513, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

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WANTED, by the Company, a thoroughly competent MANAGER with a Complete knowledge of the System of Gas Making and able to make the Most of the Residuals and Carry Out necessary Repairs to Plant, Mains, and Services (Gibbons Regenerator Settings). Annual make about 20 millions. He will also be required to Act as SECRETARY, and keep the Accounts with the Assistance of a Clerk.
Preference will be given to one who has good mechanical knowledge and experience in the Control of Men.
State Salary required.
Applications, stating Age, Qualifications, Experience, when at Liberty, and accompanied by *copies* of Three Testimonials of recent date, to be sent by the 1st of February, 1912, to the undersigned.
Canvassing the Directors is prohibited.
D. E. BAKER,
Guisborough, Jan. 12, 1912. Chairman.

LISBURN URBAN DISTRICT COUNCIL.

THE Lisburn Urban District Council invite Applications for the post of ENGINEER and MANAGER of their Gas-Works Undertaking.
The Person appointed must have had Practical Experience in the Construction and Maintenance of Gas-Works and be well Acquainted with all the Details of Gas Manufacture and Capable of Dealing with Residual Products.
Particulars of the Duties may be had on Application at my Office, and all Applications, endorsed "Gas Manager," with *copies* of not more than Three Testimonials of recent date, must be sent to me on or before the 17th day of February, 1912.
The Salary will be £225 per Annum, with House Rent, Rates, Coal, and Gas Free.
Canvassing, either Directly or Indirectly, will be deemed a Disqualification.
T. M. WILSON,
Town Hall, Lisburn, Town Clerk.
Jan. 31, 1912.

REPRESENTATIVE required to call on Gas and Water Companies, Surveyors, &c. Applicants must possess a good knowledge of Main-Laying. Previous Experience in Travelling not Essential, and Applications from Assistants engaged on Water or Gas Distribution Work would be considered.
Apply, by letter, stating Wages Required and full Particulars, to No. 5515, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a Thoroughly Experienced SALESMAN for Chief Show-Room of a Large Provincial Gas Undertaking. Must be a Good Commercial Man, Smart, Active, and Thoroughly Conversant with all kinds of Gas Appliances, a Good Organizer and Disciplinarian.
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WANTED, for a Works Making 130,000,000 Cubic Feet per Annum, a Smart, Reliable WORKS FOREMAN, capable of Controlling Workmen, Thoroughly Steady, with an Intimate Knowledge of Regenerative Settings, Charging Machinery, Coal Elevating and Carburetted Water-Gas Plant.
Wages, to commence £2 per Week with House, Coal, Rates, and Gas.
Applications, stating Age, whether Married or Single, with *copies* of recent Testimonials, to be sent by the 6th day of February prox. to the undersigned.
JAMES E. KENSHOLE,
General Manager.
Gas-Works, Merthyr Tydfil,
Jan. 24, 1912.

WANTED, Young Man, as Assistant SLOT METER COLLECTOR and CLERK.
Wages, to commence, 21s. per Week.
Applications, stating Age, &c., to
JAMES E. KENSHOLE,
General Manager.
Gas Offices, Merthyr Tydfil,
Jan. 24, 1912.